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ABSTRACT

This monograph provides various audiences with background material necessary to the successful establishment of an elementary school industrial arts (IA) program. Chapter 1 discusses needs of children in respect to activity-based learning and addresses concerns teachers have as they move from print media instruction to an activity-based elementary IA program. Chapter 2 describes the general tools, equipment, materials, and processes that elementary teachers have available and provides guidelines for managing the multiple activity classroom and evaluating learners in this environment. In chapter 3 is a description of aspects of early childhood development and ways in which the IA teacher may become involved in elementary school IA. Chapter 4 addresses the role of the administrator in supporting elementary IA programs and personnel. The final four chapters deal with ways of delivering elementary IA to the children: (1) incorporation of IA ideas into classroom activities; (2) organization and conducting of activities that grow out of the needs of children; (3) use of such facilities as separate mobile facilities and portable tool carts and activity centers in regular classrooms; and (4) need and procedures for diagnosing children's needs and prescribing IA activities to meet them. (YLB)

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ED198326

ESTABLISHING AN ELEMENTARY INDUSTRIAL ARTS PROGRAM

Monograph 9

Edited by

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U.S. DEPARTMENT OF HEALTH, EDUCATION & WELFARE
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FROM THE PRESIDENT

The American Council for Elementary School Industrial Arts, a council of the American Industrial Arts Association, was established in 1963 by forty-nine individuals who felt that industrial arts experiences should be provided as a part of the elementary school experiences of all children. Membership in the council has grown over the years and so have the services which are provided by the council to the membership. We hope that those who have been affiliated with us have also grown. This publication is designed to continue this professional growth in an effort that we may make good educational experiences even better educational experiences for our elementary children.

The purposes of the council are to:

. . . clarify, promote and improve industrial arts and career education as a vital part of the elementary school curriculum.

. . . coordinate, on a national level, the efforts of all who contribute to the development of elementary school industrial arts and career education.

. . . publish materials relating to trends and issues in education for young children which will be of informational and practical use to the membership of the council.

. . . organize action which will facilitate the general purposes of ACESIA, including the receiving, holding and administration of funds and property

For those who wish to become affiliated with the elementary council, informataion may be obtained by writing to:

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INTRODUCTION

Establishing an Elementary Industrial Arts Program

The purpose of this monograph is twofold: first, to provide various audiences with background material that the authors feel is necessary to the successful establishment of an elementary school industrial arts program, and second, to add to the store of information that has been collected in previous ACESIA monographs and to lay the foundation for subsequent monographs.

The first chapter, by Clarence Calder of the University of Connecticut, discusses the needs of children in respect to activity-bases learning and addresses some concerns that teachers have as they move from print media instruction to an activity based elementary industrial arts program. He concludes with ways in which all aspects of the elementary curriculum can be reinforced through the activities of industrial arts and provides some examples of how this is done.

The second chapter begins a discussion of the all important variable in any curriculum endeavor—the personnel. Ronald Koble, The Pennsylvania State University, outlines some important considerations for the elementary classroom teachers who is considering elementary industrial arts. He describes the general tools, equipment, materials, and processes that the elementary teacher may have available. He then provides the elementary teacher with some ideas and resources for program implementation and also provides guidelines for the teacher for managing the multiple activity classroom and evaluating learners in this kind of environment.

John Lucy, California (Pennsylvania) State College describes the aspects of early childhood development that may be foreign to an industrial arts teacher, and he informs the industrial arts teacher of way to become involved in elementary school industrial arts.

Richard Brown and T. Gardner Boyd, Kansas City Public Schools, discuss the all important role of the administrator in supporting elementary industrial arts programs and personnel. This chapter will provide guidleines to the administrator as well as to the classroom teacher who is looking for administrative support.

The final chapters of the monograph deal with a variety of ways of delivering elementary school industrial arts to the children. Norma Miller, an elementary classroom teacher in the Green Local Schools, Summit County, Ohio, begins this section with a detailed description of how she was able to take the ideas of industrial arts and incorporate them into her classroom activities. These were not "added-on" to the curriculum but were an integral parrt of the classroom experience.

Wesley Perusek, New Jersey State Department of Education, continues this section by giving an analysis of how industrial arts activities can contribute to the experiences of a child-centered curriculum. He discusses and illustrates several ways or organizing and conducting activities that grow

out of the needs of children. Since the need for some type of facility is often a concern with elementary school industrial arts, E. Allen Bame and Charles A. Pinder, Virginia Polytechnic Institute and State University, discuss important facility questions ranging from separate mobile facilities to portable tool carts and activity center in regular classrooms.

The concluding chapter of this monograph is a return to the primary concern of all persons involved with elementary school industrial arts—the children. George Baker, Northern Michigan University, describes the need and the procedures for diagnosing childrens' needs and prescribing industrial arts activities to meet those needs.

A monograph as diverse as this one is trying to serve a variety of needs. It is the purpose of this monograph and all efforts of ACESIA to provide programs for the elementary children in today's classrooms so that the benefits of elementary school industrial arts will be available to more students in a variety of operational settings. The user of this monograph are the individuals who will make the real contribution toward this goal.

Michael R. White, Editor
University of Northern Iowa
1980

Elementary School Industrial Arts
The Benefits for Children

by

Clarence Calder

Elementary school children are a diverse group of individuals with a wide range of varying abilities and characteristics. Due to these different abilities and characteristics, classroom teachers are obligated to treat each child on an individual basis. Consideration for these differences requires a curriculum incorporating learning experiences which can be adapted to meet the unique learning style and needs of each individual. Activities developed based on gereral curriculum goals should be planned with consideration for the ways in which each child best learns, with the objective of providing a learning enviroment which will enable each child to utilize innate abilities to their fullest degree.

What content should be included in the scope and sequence of the elementary school curriculum? How should the age-in-grade level placement of this content be determined? These questions are usually answered by curriculum planners creating a curriculum for hypothetical children with average ability. Curriculum specialists have given little recognition to individual learning styles and the relationship of how the child learns when exposed to any segment of the curriculum at a given time. Science, industrial arts, social studies, English, mathematics, and other areas of the curriculum are most frequently characterized as age in-grade placement. Second grade science, third grade industrial arts, fourth grade language arts and fifth grade mathematics are fairly common terms for expressing the relationship of curriculum to age-in-grade placement. The scope and sequence of the curriculum is usually planned with little, if any, consideration for the special needs of the learner. In most instances, the curriculum is planned before the teacher has met the children who will be in the class for the coming year. Teachers, consequently, have limited input into the establishment of the scope and sequence of the curriculum to be used.

Komoski (1978) points out that unless a significant commitment is made to the process of choosing and using instuctional materials, the curriculum ultimately practiced in the classroom will end up quite different from the curriculum described by the curriculum office. This statement is based upon the premise that materials play a major role in providing both structure and moment-to-moment teaching /learning activities within the classroom.

Teachers and students in schools are involved for the most part in verbal learning. Reading, writing, speaking, and listening are the processes of education. However, there are many students who daydream when reading, who tune out instead of listen, and who will put only marginal effort into writing and speaking. These are the students who, through lack of interest, are not reaping the benefits of verbal learning. There are many other students who are in the classroom without sufficient skills to profit from the

level of verbal learning. These are the students who are below grade level in reading and language skills, or who come from homes where there is limited conversation or where a foreign language is spoken, or who for various physical, psychological, or other reasons have not developed verbal skills.

To these students more verbal learning using the same abstract stimuli at a higher level simply puts them further behind until trying to learn is dismissed, and they just put in time until the day the legal dropout age is reached. Or, sporadic efforts are made and with insufficient assistance, students are passed along from grade to grade without having received any real education.

Although verbal learning is the "stuff" of education, a variety of approaches and activities, many of them nonverbal, can, by the very fact of student involvement, stimulate the student's intertest and provide satisfaction in a task well done. In certain instances learning through elementary industrial arts type techniques can take place with as limited amount of verbalization and then can provide the success mode that makes verbal learning possible.

Bloom (1963) defines a learning experience as "an interaction between the learner and his environment"; education as "a system of learning experiences which brings about desirable changes in students"; and learning as the "changes due to experience in a student's way of thinking, feeling or acting." He also indicates that not all learning experiences are educational. Random life experiences, which are occurring all the time, are not necessarily educational.

However, educational experiences within the classroom should not be random. Planning for educational experiences should start with an assessment of the learner's capacity at the moment and proceed by determining the steps necessary to promote the student's advancement to a new level of competence or maturity.

From these statements the following characteristics of learning may be summarized:

1. Learning results in a change in behavior.
2. Educational experiences should be carefully planned to promote desirable learning. Planning entails:
   a. Meeting and learning about the students.
   b. Determining what the students want to learn and/or what the parents want them to learn.
   c. Determining the characterics of the student, capacities, state of readiness, and the methods of learning.
   d. Specifying the goals of instruction.
   e. Breaking the goals down into smaller, teachable, and measurable objectives that, when achieved lead to the realization of the goals.
   f. Selecting instructional techniques to bring about the desired behavioral changes.
   g. Selecting materials and activities that provide an environment in which interaction can take place that will enhance the learning process.

h. Implementing the instructional program which represents the actual teaching act.
i. Measuring student's progress in terms of the stated behavioral changes, and
j. Providing a way to evaluate instruction in relationship to the student's progress and to make appropriate revisions.

The Learner and the Learning Style

The classroom teacher needs to consider the following questions before designing any learning experiences for an individual: 1) What motivates the child to learn? 2) Under what type of environment will the child learn best? 3) What interests the learner?

The classroom teacher also needs to consider the following questions before selecting the most suitable instructional materials and learning experiences for future learning. Can the child learn from printed materials, or does the learner require a variety of visual stimuli? Is the learner confused by a multisensory approach or does such an approach assist the child's learning process? Are deficiencies for the child's learning process the results of a lack of exposure to certain types of media or because the learner has not yet acquired the skill to use a particular type of media effectively?

It is also important for the teacher to have an understanding of what type of learning environment is necessary for the child to function with the highest degree of success. Does the child require a highly structured environment or one with a low degree of structure? Within the low or highly structured environment what degree of structure is needed by the child for the learning process to be effective? The answers to the following questions may assist the teacher in obtaining the information necessary to determine the type of environment required by the child for the learning act to be successful. Does the child require rather explicit directions when starting any task? Does the child require constant teacher intervention and guidance? Can the child work from a series of facts to form a generalization?

The need for considering these questions when planning any type of learning activity for children is supported in the writings of Hunt and Gregorc and Ward. Hunt (1971) states that an individual with a low conceptual level, usually needs tasks or educational approaches of low complexity, with high sequence, and a clear establishment of the rules while an individual with high conceptual level usually needs a very emergent structure with a high degree of task complexity and interdependent social system. This approach to teaching requires a teacher who can establish a variety of environments depending on the children's characteristics. For those children having a low conceptual level, the teacher needs to be fairly controlling, clear when presenting directions, very supportive, but direct. However, if the child has a high conceptual level, the teacher needs to be much more interdependent and mutual, placing much more of the burden for learning on the children, but always helping the students develop their own structure.

Gregorc and Ward (1977) found that learners could be classified into one of the following types: Abstract Sequential, Abstract Random, Concrete Sequential, and/or Concrete Random. Although all learners in the

study used all four modes to learn, ninety percent of the individuals interviewed expressed a preference for one or two methods of acquiring information.

When learning styles are considered as an array, opposed to the student's functioning in only one of the learning modes, a number of questions and issues of a different nature arise with respect to instruction and curriculum development. These issues and questions will have a direct impact on the formulation of curriculum decisions related to the use of industrial arts type activities in elementary schools.

Enhancing the Basic Skills Thru Elementary Industrial Arts Activities

A major purpose of elementary industrial arts is to stimulate, enrich, and extend the learning of young children. When serving this purpose, it is not a separate subject but it is an integral part of the total elementary school curriculum. However, elementary industrial arts can make its own unique contribution to the total education of the child. Industrial arts in the elementary grades should be interwoven into the study of man and his technologies and how these have shaped the environment. It should encompass much more than building objects out of wood, metal, and paper. Elementary industrial arts should be a facilitator of instruction as well as content. Through its activities it becomes possible for children to study the 3 R's in a three dimensional perspective, for words, pictures, and ideas can be given form, detail, and color. Elementary industrial arts contributes to the personal development of children and aids in introducing students to materials and activities to interpret the environment.

Research in the field of child growth and development has led to increased knowledge and much better understanding of children and the process of learning. Erickson (1963) terms the psychological stage of development for children beween the age of five and twelve as the "Age of Industry." The child, during this period, should be active: tenkering, manipulating, taking apart, putting together, building, tearing down, and building up.

Burton (1962, p. 19) defines learning as "a change in the individual, due to interaction of that individual and his environment, which fills a need and makes him more capable of dealing adequately with his environment." The research indicates learning is much more effective when there is a strong desire to learn on the part of the child. Therefore, it seems reasonable to conclude that basic skills are more readily acquired if these can be reinforced through experiences related to the child's environment. Since so many aspects of elementary industrial arts are familiar to children, it only seems reasonable to reinforce the basic skills through the use of these activities in which children have a natural interest and desire.

Elementary industrial arts activities can also be used to stimulate, enrich, and clarify instruction in other content areas. It serves as a cognitive link because it provides a technique by which other content within the curriculum can be applied. Classroom teachers should analyze how elementary industrial arts type activities can be used to reinforce the basic skills of reading, writing, speaking, and listening. If used wisely, these activities will

enhance the learning environment and encourage the child to explore and react to the technological environment. These activities encourage children to use basic skills to seek more information related to a specific topic or activity and gradually shape instructional strategies to a renewed emphasis on the effectiveness of first-hand experiences in acquiring those skills necessary for effective living in the home, school, and community.

Although elementary industrial arts has unique values, both aesthetic and technical, it can effectively reinforce the process of learning in all areas of the elementary curriculum. A few examples illustrate various types of industrial arts activities being used - both as a method for learning and as a content area. It represents both content and and instructional strategy.

The first example illustrates a technique for using materials from the learner's environment to stimulate the learning of basic skills. A fifth grade teacher in an attempt to motivate a non-reading, non-writing child, brought to the school an old ten speed bike and some simple tools. The child was interested in taking the bike apart. However, the teacher told the child that she did not know how to take the bike apart. The teacher suggested that if the child was interested in taking the bike apart, he should get a notebook and pencil and list the steps used to take the bike apart.

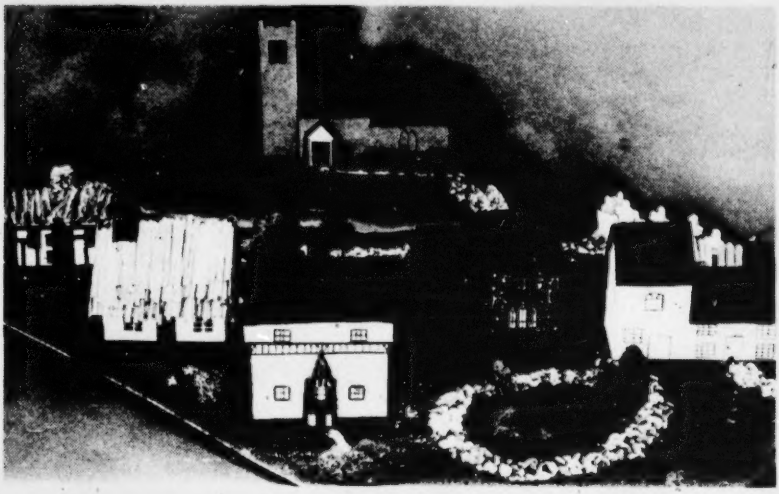
While the child was disassembling the bike, a list of the steps was developed, complete with a diagram showing how the bike had been taken apart. Later the child made the list of directions more sophisticated by naming bolt and wrench sizes and the types of screwdrivers used. With the bike apart, the child, a limited reader and writer, was asked to make a second list as he reassembled the bike. The learner was asked to share the lists and diagrams with his classmates. This experience provided the learner with an

opportunity to develop writing, reading, and expression skills and technical skills as well as some peer respect for his capabilities.

The construction of models is another activity that can enhance the basic skills. The use of model building is an effective approach to help the learner develop a sense of structural visualization. Through this method, a learner or a group of learners can create objects that reflect real life environments of both the past and present and perhaps even the future. Learners like to manipulate materials. For many, model building is an enjoyable activity. Therefore, the transition from the familiar building blocks of the home or school to the construction and placement of scale models is an enjoyable one.

Along with the obvious appeal to children for building miniature structures, various academic disciplens of the school curriculum come into play as well. Mathematics is involved in the scaling of a structure. Here the ability to measure and work with fractions is essential to achieve proper proportions, shapes, and sizes of the buildings. As construction gets underway from the planning stage, the use of hand tools helps develop the necessary motor skills. However, it may be the visualization of how the pieces of wood go together to form a particular structure that is most important for the very young child.

This is an excellent activity for developing the concept of working together. The children may start the activity by planning together and selecting a topic to investigate. However, they may work independently on constructing a particular structure. When the various structures are completed and put together, the teacher should develop the concept of how important it was to work together to plan the size of each structure. Discussions can also be helpful concerning what could have happened if a common scale had not been used or if sound construction techniques had not been employed.



A great value of constructing models of things the students have only read about lies in the area of the communication skills. Here it provides experiences that help develop and reinforce skills in learning to read, in following directions, in using the library, in building vocabulary, and in basic kinesthetic or manipulative skills and visualization abilities. The theme of "Homes Around the World" will serve to illustrate.

In attempting such a project, the children must first search out resource material. The school library would be a logical place to begin. This will necessitate the use of reading and library skills in research to find information that is pertinent. Map skills will be developed as discussion and selection of countries occur.

In addition to the material found in books and maps, the children should also be aware of other possible resources. Are there any individuals in the community who are from other countries? These people may have pictures and objects to show to the class. Several children may wish to interview these people and report back to the class. Others could write to travel bureaus or to embassies seeking more information and illustrations. Slides and post cards could also be used as resource materials. The emphasis should be on the search for materials and not on the finished product.

Discussion with teacher, classmates, and resource people goes along with the amassing of this information and the progress of constructing the buildings. Questions arise. Why are the buildings in various parts of the world built out of such different materials? Why is the architecture so different? What kinds of things influence the style of architecture& Why don't many modern buildings have the detail and ornate sculpture of buildings built long ago? These are just a few of the kinds of questions that may be asked. Decision making is an important aspect of the planning and construction stages of model making. After collecting information about a topic the children must decide which structure they will make. Structures should be selected that best represent or tell the story about the topic being depicted.

Some of the above concepts are quite abstract and therefore may be difficult for an elementary school child to grasp. Through the medium of construction and the skills it employs, a child has a concrete and visual means of coming to grips with the world.

Summary

The individual differences of children are recognized and cared for in a well-planned and well-organized elementary industrial arts program. An effective program takes into consideration the child's learning style, level, and speed. Children participating in the program usually gain many concepts that would have been difficult or impossible had only textbook learning been used. Elementary industrial arts provides children an opportunity to see things done, hear reports and discussions, view films and filmstrips, and actually participate in the construction of objects. Most of these activities exhibit characteristics that permit children to be successful by utilizing hands-on "doing" activities as opposed to strictly projects involving reading and writing.

Children also find elementary industrial arts activities a useful vehicle to enhance learning. Industrial arts activities enrich and extend learning by fostering further reading in stimulated areas of concern. Children are encouraged through industrial arts activities to construct authentic replicas of things studied and to learn to work cooperatively with others.

In the hands of an effective teacher, elementary industrial arts type activities arouse the children's interest and curiosity. Youngsters are provided with a down-to-earth practical approach to almost any problem. Elementary industrial arts is seldom inseparable from other areas being studied by children. It provides the elementary classroom teacher with an excellent vehicle to enhance the basic skill areas and to make learning more fun and exciting to a greater variety of students with varying areas of skills.

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Selecting Materials, Tools, and Supplies for Elementary School Industrial Arts

by

Ronald L. Koble

This section deals with what elementary teachers need to know in order to successfully conduct industrial arts activities for students. In addition to books, pamphlets, and other printed materials, teachers in the elementary school can help prepare themelves to conduct industrial arts through courses offered by colleges and universitites, workshops and other in-service activities offered by school districts, assistance provided by industrial arts consultants, industrial arts teachers at the secondary level, assistance provided by parents, relatives and other craft people, and through self-study. Regardless of the source of assistance, teachers need to realize that after a fundamental understanding of the elements of an elementary school industrial arts program have been established, the next step is to actually begin working with students. The first steps may be small and involve only one activity. Teachers and students can begin with only a few tools and materials for this first project and then expand into other acivities as more experiences and supplies are gained. It should be stressed that the information that follows offers suggestions but not **all** of this or even **most** of this is necessary for a successful, exciting program.

Knowing About Materials

A wide variety of materials can be used for industrial arts activities with elementary school students. Wood and materials made from wood; plastics; metals, in sheet, bar, rod, and pipe form; ceramic materials including clay and plaster; and leather can be used by elementary school students for industrial arts activities. The characteristics of these materials are described in Table 1 along with an index of availability, cost, and ease with which elementary school students can use the materials. By no means is this a list of all materials that can be used. It does serve to illustrate some of the diverse materials that are available.

The "Availability" index used to classify the materials was: '3'—available in most areas, '2'—sometimes available, and '1'—not available in many areas. In metropolitan areas all of the materials listed are available, but in small towns or rural areas, some of these materials can be obtained only by special order.

"Cost" of these materials in more difficult to categorize due to price fluctuations, source of supply, unit cost, amount purchased, and quality of materials. In this category the two classifications used were: 'E' (expensive) meaning other less costly materials are available, and 'L' (less expensive) meaning the material is likely to be cheaper than other material that could be used.

"Ease of Use" indicates the ease with which an average elementary school student can use the material. The index used to classify the materials

was: '3'—material easy to use, '2'—material difficult to use, and '1'—material very difficult to use by elementary school students.

TABLE 1
Materials For Elementary School Industrial Arts Activities

MATERIAL	DISCRIPTION	A	COST	USE
I. Wood/Wood Products:				
Basswood	Soft tan-colored wood without knots. Ideal wood for industrial arts acitivities.	2	L	3
White Pine	Soft yellow-white colored wood. Clear grade is ideal but expensive. Grade No. 2 can be used.	3	L	2
Hardboard	Sometimes called "Masonite". A brown sheet material either 1/8" or 1/4" thick. Sold in 4' x 8' sheets.	3	L	2
Insulation Board	A soft 1/2" thick material sold in 4' x 8' sheets. Good for bulletin boards. Painted white on one side.	3	L	3
Cardboard	Available from discarded cartons. Sold in double and triple thickness. Can be used in place of wood for some activities.	3	L	3
Plywood	Sheets are 4' x 8' and consist of many layers of wood. Available in 1/4", 3/8", 1/2" and 3/4" thickness.	3	E	3
II. Metals:				
Aluminum	Soft, non-rusting silver-colored metal.	3	L	2
Copper	Soft, non-rusting red/orange colored metal.	3	E	1
Brass	Soft, non-rusting, yellow colored metal.	3	E	1
Tin Plate	Used to make tin cans. Bright, silver colored metal. Rusts easily.	2	L	1
Galvanized Iron	A silver-colored metal used for buckets. Does not rust easily. Hard to cut.	3	E	1
III. Plastics:	There are thousands of type of plastics available at the present time. Flexible or rigid sheets of plastic, usually clear, are used.	3	L	3
IV. Ceramics:				
Clay, Slip	Processed earth that can be shaped easily but requires a kiln to permanently harden. Slip has the consistency of thick cream.	2	L	3
Plaster of Paris	A white powder that hardens soon after being mixed with water into a rigid mass. Clean-up a problem.	3	L	2
Keene Cement	Similar to Plaster of Paris but cures more slowly. Both must use a mold.	3	L	3
V. Leather:				
Calfskin	Very smooth flexible leather having a thickness of about 1/16". Available in many colors.	2	E	2
Cowhide	Strong, fairly rigid leather usually 1/8" yo 1/4" thick. Mostly tan color.	2	E	1
VI. Hardware/Paint:	Paint (latex), shellac, abrasive paper, glue, nails, screws, bolts, hinges, etc.	3	L	2

Wood and materials made from wood are the most commonly used materials for industrial arts activities. Many reasons can be attributed to this practice including the availability of wood and tools for working with wood, the common use of wood among the general population, and the success usually experienced by elementary students when using this material. In contrast, most metals are difficult to cut and bend, and the sharpness of

metals creates a safety concern. Work with clay and other ceramic materials is included in some elementary school industrial arts activities but more often than not is part of art education programs. Plastics in thin, flexible, or rigid sheet form are used sparingly in elementary programs, and other forms of plastic are used very little. Leather is an attractive useful material but if fairly expensive, and requires careful manipulation to achieve attractive results. One advantage is that it requires only a few simple, fairly inexpensive tools.

These materials can be purchased from building supply dealers, craft shops, hardware stores, and sheet metal shops. In many school districts, elementary teachers can obtain supplies or names of vendors of materials from industrial arts teachers, supervisors, or elementary industrial arts consultants already employed by the school district.

Knowing About Tools

A variety of tools are needed to layout, cut, smooth, and assemble materials. Someone with limited knowledge about using tools should select one product and learn to use the tools to construct that product before using other tools.

The use of specialized tools should not, however, cause an elementary teacher to avoid getting into industrial arts activities. A teacher can start with something as simple as scissors and cardboard to begin construction activities. As the teacher and students gain experience with a wider variety of activities, additional materials and tool processes will become familiar and easier to do.

Working with Materials

Given adequate materials and tools, another kind of information and insight is needed to complete industrial arts activities successfully. Knowing how to drive nails, work clay, set rivets in leather, and join parts for a project or deciding whether it is easiest for elementary students to glue, screw, or nail a trivet together is very critical. Experience has shown that special care must be taken to try to select the simplest, most durable processes for industrial arts activities.

Special ways of processing the materials used by elementary students, including some unusual techniques to promote greater student success than more traditional methods are suggested below.

Processing Wood and Wood Products

1. Provide a mitre box or cutting jig if the size of a part must be exact.
2. If students have trouble measuring, provide a 'pattern' that can be used for laying out stock.
3. Avoid using planes since students do not have the strength to push and control them.
4. Chisels are too dangerous for children to use.
5. Pre-cut critical size parts if possible.

6. Use poster or latex base paints; avoid oil base paints and stains. Always make sure children wear aprons when painting.
7. Use only butt or lap joints.
8. When joining several pieces of wood, make sure the pieces into which nails or screws will be fastened are the thickest.
9. Provide patterns to help children locate screws and nails.

Processing Metals

1. Round corners and smooth edges of sheetmetal to avoid cuts.
2. Paper fasteners can be used to join sheetmetal.
3. Nails can be used to 'punch' holes in sheetmetal.
4. Avoid using thick sheetmetal or rod, bar, and pipe stock metals.
5. Pop rivets can be used to join sheetmetal.
6. The edge of a half-round file can be used to cut heavy wire.

Processing Ceramics

1. Pinch-pot, slab, or coil building are the simplest ways of forming clay.
2. Clay that does not need to be fird in a kilm is available.
3. Store clay in plastic bags to keep it soft.
4. Ask students to put their initials on the bottom of clay work for identification.
5. Students can make clay slabs by using the heel of their hand to spread the clay on waxed paper.
6. Use glaze that fires at the same tempeature as clay to simplify firing.
7. A water-flour mixture is a good substitute for plaster of Paris.

Processing Plastics

1. Limit the use of plastics to thin vinyl or cellulose sheets, or 3/32" poly carbonate (stormdoor 'glass') plastic.
2. Rigid plastic sheets can be cut by scribing and then breaking, rather than cutting.

Processing Leather

1. Use as few pieces of leather in an activity as possible.
2. Rivets and glue are easier ways of joining leather for elementary students than sewing or lacing.
3. Small off-lot pieces of leather can be used for many activities.
4. Store leather in a cool, dry place.
5. Avoid using more than two or three thicknesses of leather.

Knowing How and Where to Get Help

A variety of sources of information and other assistance is available in most communities. Generally, the best approach to use is to simply outline what outcomes and objectives are desired through an industrial arts activity or specifically state exactly what problem exists.

The following resources and resource people are available to provide activity suggestions, to recommend tools and materials to use, or to advise what processes would be ideal for industrial arts activities.

Vendors—Clerks and other personnel in hardware stores, lumber yards, craft supply houses, and building supply stores are excellent sources

of information and assistance in selecting tools and materials, and also in getting ideas for activities.

Craft People—Carpenters, potters, shoe repair people, and others who commonly use tools and materials are excellent sources of information and assistance. Beware, however, of conflicting advice from different people.

Teachers—Industrial arts teachers from middle, junior, and senior high schools as well as teachers of art or vocational eduction are good sources fo help.

Parents—In many instances parents are excellent sources of advice and information, as well as actual assistance to carry out industrial arts activities with students.

Industrial Arts Consultants—In some school districts, industrial arts consultants are employed to provide all of the support services that elementary school teachers need to conduct a worthwhile program for students. Typically, the consultants purchase materials, maintain tools and equipment, suggest activity ideas to teachers, conduct in-service training for teachers, and prepare materials needed by students. It is unfortunate that more school districts do not have these consultants.

Books and Other Printed Materials—Reference books, students textbooks, workbooks, catalogs, educational periodicals, and magazines are examples of the many published materials that are excellent sources of information and ideas.

Knowing How To Organize and Conduct Industrial Arts Activities

Regardless of where industrial arts activities will be conducted, there are some common prerequisites that should be considered before undertaking any activities.

Planning—The success of any activity is influenced significantly by the amount of planning completed before the activity occurs. Enough materials for all student plus about ten percent extra to allow for breakage or misuse are needed. Sharp tools and a planned time schedule are also needed. The most important thing a teacher can do to insure the success of an industrial arts activity, however, is to make or 'tryout' the activity. Determining what 'works' beforehand is critical especially with musical instruments or anything that have moving parts. Students also can be involved in planning, such as choosing between alternate activities, in computing (mathematics) the amount or cost of materials that are needed, or outlining (language arts) how the class will proceed with the activity.

Preparing Children—An ideal way of creating interest by children in an activity is to show them a sample of the activity or picture of the activity a day or two before they actually begin working.

Demonstrating Tools—Prior to using tools, teachers must demonstrate the correct use to students. Although tool demonstrations are not particularly unique, there are some special guidelines that need to be remembered.

1. Show only the correct way to use a too. Students may not remember the correct way if you show them the correct and the incorrect ways.

2. Make sure all students are positioned so that all information can be heard.
3. Incorporate safety in all demonstrations.
4. Make sure all students can see what is being shown. Remember students must mentally reverse what is seen in tool demonstrations when the tools are actually used.
5. Provide an opportunity for students to use a tool during or following a demonstration if possible.
6. Show students how to use tools right before they need to use the tool.

Storage of Materials—If an activity will require more than one day to be completed, make sure that space is available for each student to store the materials. A student's name or initials should be put on all the materials. Plastic bags are excellent 'containers' for storing small parts that might be easily lost.

Knowing Children's Psychomotor Abilities

Since industrial arts activities require students to manipulate tools and materials, there are some special considerations related to childrens' motor abilities that need to be remembered when activities are planned.

During the K-6 years, children are in the process of developing the large muscles then the fine muscles that control the ability to **swing** a hammer with accuracy, **turn** a brace and bit, **push** a file, **grasp** a handle, **turn** a wrench, and **squeeze** pliers. since all children develop at varying rates, it is in the best interests of the children to plan activities that do not exceed these abilities.

The following guidelines suggest some of the **general limitations** of elementary school children by citing the operations that are difficult for many children.

1. Ripping wood or crosscutting wood over 3 inches in width and 1 inch in thickness.
2. Driving nails into hardwood, hardboard, or materials 1/4" or less thick.
3. Turning screws into hardwood.
4. Boring holes into the grain of wood or boring holes over 3/4" in diameter.
5. Cutting and drilling holes in metal.
6. Skiving leather.
7. Swinging a hammer held near the end of the handle.
8. Holding two boards and driving a nail simultaneously.

The age, maturity, and stage of each student's motor development should influence what is required or permitted to be undertaken. Taking these factors into consideration will help insure the success of industrial arts activities for students.

Knowing How to Evaluate Industrial Arts Activities

The basis for evaluating industrial arts activities obviously depends on the reason or reasons for conducting the activity. These reasons do vary but can be included in one of the following categories.

1. Improving cooperation among students.
2. Increasing student comprehension in language arts, science, mathematics, and other subject areas.
3. Helping students learn about the industrial world.
4. Expanding student awareness of hobbies.
5. Improving student attitudes.
6. Helping students develop motor skills.

The type of 'test' used to measure student achievement in an industrial arts activity includes the techniques used by all teachers such as (1) observation, (2) written and oral informal tests, (3) standardized tests, and (4) evaluation forms that can be used by students or teachers to judge the quality of the activity itself. The latter are used very infrequently because the reasons for conducting industrial arts activities usually focus on how the activity has helped the student or what the student has experienced rather than what the student has produced. In any event, the method of evaluation is suggested by looking at the reason for conducting the activity when it was planned.

The Industrial Arts Teacher's Role In Establishing Elementary Industrial Arts Programs

by

John Lucy

Industrial arts teachers are often asked to assume leadership roles in establishing an industrial arts program at the elementary level. These teachers have a great deal of skill and experience in industrial arts, but they often lack an understanding of the elementary child and the needs of the child in relationship to industrial arts. Several ACESIA monographs in the current series have addressed this problem. Notably, monograph 6—**Implications of Piagetian Theory for Early Childhood Industrial Arts: Cognitive Development** by Richard Dahl and monograph 5—**The Developmental Growth of Elementary School Students and the Role of Industrial Arts in the Process** by Arthur Rosser. These two documents can provide a much broader perspective to the industrial arts teacher concerning the needs and capabilities of elementary students and the role that industrial arts can play in meeting those developmental needs. However, some of the developmental information is justified in this monograph and the interested reader is directed to these two previous works for additional and detailed information.

Since industrial arts teachers have the required technical and pedagogical skills necessary to teach industrial arts at the secondary level, one of the key components that is missing from their background to permit them to transfer this skill to the elementary level is the understanding of the development of the elementary age child. The developmental areas will be briefly described in relationship to the cognitive, psychomotor, and affective development of the elementary school child. If someone is about to begin planning educational experiences for use at the elementary school level, then a basic awareness of early childhood growth and development should be of great importance. To achieve this awareness, one needs to examine some of the stages of cognitive or mental growth as described in recent literature. One relevant source would be the work of Dr. Jean Piaget and his co-workers at the Genetic and Epistemology Institute in Geneva, Switzerland. Since the 1920's, this dedicated group of professionals has studied the human mind and how it develops from the unfinished stage of a small child to exhibit the operations of mature adults. In this development, Piaget has identified four major stages (Flavel, 1963).

Sensorimotor	0-2 years
Preoperational	2-7 years
Concrete Operational	7-11 years
Formal Operational	11-14 years

Prior to making any assumptions as to how this structure can be utilized in planning classroom activities, one should be aware that these age brackets have been determined by averaging a series of many observations and a teacher should practice caution when making comparisons between this data and the characteristics of an individual child. One must recognize that the rate of current development for a single person may be influenced by many factors other than chronological age. On the other hand, this

knowledge has been found to be very useful when planning and developing classroom activities for large groups of students.

Sensorimotor stage (0-2 years). This stage is so named in that during these 24 months the child learns through the use of his senses and muscular movement while being directed by sensations from without. Most of this development is achieved by an interaction with the environment which is stored in the brain for future problem solving. The child touches, pushes, and moves familiar objects while noticing that they possess various properties. During this period the infant does not have the ability to imagine objects or actions. What he perceives is in mind; nothing else. Furthermore, this child can not add or subtract and is unable to remove a distraction without forgetting where he is going. By the age of two years, this young person is able to perceive depth as well as width and length while having names for things or activities. While the industrial arts teacher would not encounter children of this age level in grades K-6, it is of utmost importance to acquire an awareness of this initial stage of development because this stage in the foundation for further development.

Preoperational stage (2-7 years). The second major stage of development has been identified by Piaget as preoperational. The term preoperational is used because the child is not yet capable of carrying on complex mental operations. Children in kindergarten through the second grade will generally be in the latter portion of this level of growth when the industrial arts teacher may encounter these students. To assist in the teacher's preparation for this initial meeting, a brief examination of the behavioral characteristics of the preoperaional child is described.

The preoperational child is no longer limited in his thinking about something in the immediate environment. On the other hand, his mental impressions are confined to past experiences. A child in the latter portions of this stage of development begins to notice differences between singular and plurals and relative sizes of large and small.

The practice of centering is a problem for preoperational children. A child's attention can be diverted to involve only one element of dimension at a time. The most often illustrated example of this immature behavior employs the use of a ball of putty. when you roll out this ball of putty, the child will notice that one dimension (length) has been increased. If you ask whether the rolled out putty weighs more, less, or the same as the ball of putty, the response will often be say that the rolled-out form will weigh more. This will still be the case even if you roll the putty into a ball form in the child's presence. In this situation, the young child has not decentered his original attention to include the concept of width.

The preoperational child will also focus attention on the stages of an operation rather than the total transformation. If the child is shown a set of drawings in which an object is illustrated in a series of sequential positions, the interest will focus on one of the individual steps. The child will often not be able to redescribe this order or to predescribe the final position or outcome.

This level of limited thinking can also be examined through the process of reversibility. In this confrontation the young child is not able to reverse his thought processes. If asked: "Is a hammer a tool?" the response may be, "Yes." Then if the teacher responds: "But all of our tools have been lost." Do you know where the hammer is?" The child may reply, "Yes, it is

in the tool panel." If the child is forced to reply concerning the location of the lost tools, the answer could be: "The tools flew away or they were taken by a monster." Here the preoperational student has not been able to determine the relationship between class and subclass or exhibit the reversibility of one's thinking.

Some additional characteristics of the preoperational child would be the inability to grasp the concepts of change and probability. The child lives in a world dominated by animistic and artificialistic influences. Mountains have been created by giants, the moon and the sun move because they want to move and familiar objects often have names, e.g., Harry, the horse, and Petey, the pine tree. The areas of reality and play are confused and the child is not able to discriminate the differences. Most of the beliefs are rather arbitrary and have not been derived from careful thought. The preoperational child is also egocentric. The child feels that everyone sees the world just as it appears to the child. If there are any changes in this egocentricity then this is usually brought about by social interactions with others. The concept of time has been enlarged to an awareness of the future and tha past while feelings of space have been expanded to include the home and the neighborhood.

In summation, the preoperational child is in a period of learning how to deal with his immediate environment. It is a period of trial and error and a time for collecting meaningful experiences for future use and adaptation.

Concrete operational stage (7-11). These four years represent a period of transition in which the child is slowly beginning to refine the ability to perform logical and infralogical (below logical) operations. The industrial arts teacher who is about to assume the responsibility of planning ESIA activities for this age child should become very familiar with the operations listed below. Since elementary school industrial arts is more than just "making useful items," these cognitive behaviors should be reinforced by the content of the classroom activity in which the student is planning and developing solutions to his encountered problems. As identified by Piaget, these infralogical and logical operations would include the following (Sund, R. B.; Trowbridge, L. W., 1973).

Infralogical Operations

Observing	Looking at something critically
Measurement	How long, high, what volume, etc.
Quantity	How much
Time	Now, future, past
Classifying	Grouping according to similarities
Space	Room, home, community, country, continent, world, universe
Interpersonal reactions	Getting along with others, noting the effects of one's behavior on others
Values	Establishing values

Logical Operations

Adding	Combining
Subtracting	Taking away
Multiplying	Repeating
Dividing	Repeating subtraction
Correspondence	Aligning one row with another row
Placing in order	This is greater than or this is less than

Substituting	Replacing something similar with another entity
Reversibility	Subclasses belong to a class—a class has subclasses

The concrete operational child is constantly organizing experiences into cognitive structures or ideas. The child is able to perform reversible and decentering thinking but is usually limited to the use of one hypothesis or unknown concerning objects that are presently in view of the class. Solving problems in a total mental approach at this age is extremely difficult for the child. In an industrial arts setting, a group of concrete operational children might be found considering which materials might be most appropriate for constructing a project. The initial discussion of these materials should include the listing of the characteristics of the object (strength, cost, availability), and then the students could collect various samples, drawings, and photographs for group consideration and possible construction. In this manner, the children are able to sense as well as discuss this most important decision, one factor at a time.

Formal operational stage (11-14 years). Since the adolescent age group would not usually be considered as part of an elementary school program, a complete description has not been included. Briefly, however, in this period, the student has usually progressed th the point where there is freedom to establish thinking without the use of external stimulants. The student is able to reflect, or in plain words, able to think about one's own thinking. This student is now able to answer this question, "How would you change your approach in given a second opportunity?" The adolescent can deal with realities as well as ideals.

Psychomotor Development

Since industrial arts has always utilized tools and materials in its reflection of the man-made world, it is quite obvious that efforts in grades K-6 would be concerned with psychomotor development. Historically speaking, man's cognitive and psychomotor developments have been credited as being the controlling factors that have enabled man to deal with the environment. It has been these abilities to conceive and use tools that have elevated man to the present position.

In respect to psychomotor skill development through elementary industrial arts, the industrial arts teacher should find some guidance from the following that will prove helpful and thought provoking.

1. All students develop at different rates which include the acquisition of physical skills.

2. The process of psychomotor development is slow and deliberate and little can be done to speed it up.

3. Children are active by their general nature, thus physical activity needs to be a part of the educational program. Industrial arts at the elementary level gives an opportunity to plan, build, construct, and to be successful in a physical way.

4. While children need to be active, they also tire and recover very quickly (Cratty, B. J., 1973). All teachers should plan the lessons to include periods of demonstrating, working, discussing, and if necessary with primary level children, resting.

5. The muscles of the body are commonly grouped into two main classifications, fine (small muscles) and gross (large muscles). It should also

be noted that while these two classifications can be identified for the purpose of study, these muscles are not independent of one another in function and/or training (Gerbracht, C. and Babcock, R. J., 1969).

6. In general, the development of the large muscles occurs at a much earlier time than the fine ones. Most children have gained fairly good control over their gross muscles by the age of six to eight years. Therefore, the sweeping motions necessary for using a saw or a hammer are much easier to achieve than the correct manipulations of the screwdriver or engraving tool. The acquisition of fine motor skills usually begins to appear in grade four where students are nine or ten years old.

7. One misconception for many children who are attempting to achieve any type of physical development is that strength can be a functional replacement for skill. In industrial arts, teachers often observe a child who is lacking in the proper skills for using a common hand tool such as a brace and bit. This student has made the incorrect assumption that rapid and erratic turning movement of the brace will substitute for lack of physical skills. It seems that the harder the child tries, the further the child gets from the goal of producing a round hole in the project. The teacher should be aware of the possibility of this situation and be ready to provide close supervision and assistance at the proper time. In some instances, a change in the activity may also be needed.

8. For most young persons, the strength for gripping with their hands is usually not achieved until during the years of adolescence. While at first this may not seem to be of major concern, an awareness of this physical condition is necessary for planning elementary school industrial arts activities. Some of the hand tools successfully used in grades 7-12 require a strong grip for proper operation. An example of this type of tool would be the hand punches for producing holes in light gauge sheet metal or leather. Students in grades K-6 may be unable to squeeze the handles of these punches tightly enough to produce the desired hole. To avoid this problem, the industrial arts teacher can devise hollow or solid dies from short pieces ot tubing or solid bar stock. Then with the use of a ball peen hammer and a backup block of hard wood, the same results are achieved in punching sheetmetal, paper, cardboard, or leather. In this manner, the young child is able to be successful in the activity while using strengths (gross arm muscles) and not weaknesses (strength of hand grip).

9. The acquisition of skill requires the coordination of the timing of muscular contraction and relaxations. In this learning sequence, each muscle must learn to contract and/or relax in perfect harmony with one another or the movement will be misdirected. In the initial stages of this development, the eyes are the dominant controlling factor through observations of the elements of distance and movement-in-space relationships. Therefore, the teacher should provide ample time for these immature learners to observe and to imitate these needed physical movements.

An effective elementary school industrial arts program will have to utilize well-planned demonstrations which stress the acquisition on one psychomotor skill at a time. These movements should be studied by the teacher prior to the actual presentation in the classroom to determine their substructures. What the industrial arts teacher can perform skillfully and quickly, may be overlooked by the young student. For example, driving a nail with a claw hammer is really a series of individual acts which might in-

clude: (a) Holding the hammer with the dominant hand near the end of the handle; (b) turn the handle in your hand until the face of the head is towards the workbench; (c) swing the hammer in an arc towards the workbench by bending the arm at the elbow; and so forth. In this manner, the teacher has a much greater opportunity to make the child aware of each individual movement which could be lost without the proper approach to such details.

10. The level of muscular tension involved in performing a task affects its energy requirements, the rate of body movement, and the onset of fatigue. While this level can be measured, the control of its presence can affect the learning situation in various ways. Morehouse and Miller (1971) have described this condition in the following manner.

> Too much tension makes movement jerky, awkward, and often painful. Too little tension makes movement weak and unsteady. Mental and emotional experiences affect tension. States of sadness and depression diminish tension and result in slouched posture and 'half-hearted' movements. States of happiness and confidence elevate tension and result in more erect posture, alertness, and movements that are more direct and less fatiguing. Fear and intense excitement can increase tenstion to the point of incapacitation contracture ('scared stiff') and resultant muscular fatigue. (p.55)

The industrial arts teacher should alter his instructional efforts and classroom supervision to provide the children with verbal assurances and directions that accentuate the positive rather than the negative. One example of this approach to controlling the level of tension would be, "Please saw on the line, Mary. I know that you can do it!" rather than, "No, you are doing it wrong, Mary!" Another misjudgment in working with young students might be to say, "Here is your piece of leather. Do not make a mistake for our supplies are very limited. There are just enough pieces to go around once." In this latter situation, the over cautious industrial arts teacher is preprogramming the level of tension in his class to the point where the students are sure to exhibit many jerky and awkward movements. Whether or not there are additional pieces of leather available for use by the class is not the question. What this teacher needs to do is to provide a program of positive, reinforcing conditions that raises the level of tension only to the point of being alert. In other words, this might be changed to include this type of comment. "Here is your piece of leather. I want you to try very hard to do your best work. If you are not sure of what it is that you are to do, please hold up your hand and I will assist you."

11. Thinking about an upcoming performance can actually increase the level of performance through the proper amount of tension created in the affected muscles. This situation occurs in the off-season when a golfer improves his swing by reading and actually experiencing the tension of his affected muscles when visualizing the physical movements needed for driving a golf ball down the fairway. An industrial arts teacher can utilize this phenomenon by having one student attempting an activity while his classmates observe and answer questions concerning the on-going performance. In this manner, a skillful teacher can "physically" involve all members of the class in a demonstration prior to the actual work session.

The teacher's questions should point out the proper physical movements and the feelings of the demonstration class member. Several examples could include, "Which direction is Jimmy turning the crank on the hand drill, clockwise or counter-clockwise?" or "Jimmy, is the bit turning easily or not?"

12. Accuracy and speed are best achieved when both hands are used simultaneously. An example of this in elementary school industrial arts would be having the students place both hands on a saw or wood rasp when separating wood. In addition to being more accurate and faster, this type of physical movement does not place an additional strain upon the child's limited source of energy.

13. In preparing for psychomotor development, knowing which movements are easiest and the most accurate to achieve can be useful to the industrial arts teacher. The teacher can analyze each skill into its various individual movements and is then able to make a wiser selection based upon the perceived needs of the children during the industrial arts activities. One additional factor regarding the achievement of physical skill has indicated that tasks which involve a movement away from the body are performed with less error than those which are moving toward it. The literature also states that movement in a downward direction is usually inaccurate due to the possibility of overshooting. In this same concern for the direction of movement, it has been identified (Miller, W. R,; Boyd, G., 1970) that the most accurate motions of the right hand are in an counter-clockwise direction and in a clockwise direction of the left. This type of predictive result can be of great assistance when planning a lesson such as cutting a linoleum block for printing in visual communications. Once the block has been secured in the bench vise, the question of which direction should the students move the engraving tool in the dominant hand is no longer a problem.

14. Students enrolled in the primary grades are immature in various ways. One of the most predominant physical limitations at this level of development is natural farsightedness. Due to this situation, it would not be wise for a teacher to select an activity which reqired these students to work with small objects at close distances for long periods of time. One example of the modification of activity would be in the selection of long handled artist brushes for painting a design. This change permits the students to work at arm's reach, thus permitting the eyes to focus more easily.

Affective development

While a successful teacher must be able to foresee with some degree of accuracy cognitive and psychomotor development, it is also of equal importance to be able to plan for desirable behaviors in the affective or attitudinal domain. While an all inclusive listing in this one remaining area could become rather lengthy, the following information contains some of the most common concerns for the beginning elementary school industrial arts instructor.

When children enter the elementary school, the tendency in to be egocentric, boastful, possessive, exhibit few inhibitions, while growing socially at different rates. Therefore, the industrial arts teacher needs to utilize activities which assist in the development of interdependence on the part of these young children. Due to its very nature, elementary school in-

dustrial arts is often an excellent situation for initiating lessons which reinforce the sharing of tools and materials and working together.

In working in elementary school industrial arts, the child can receive other positive experiences when working with tools. In addition to assisting fellow students, children often benefit by following set procedures in the classroom. Treating tools with care and respect and putting them away at the end of the work session are valuable lessons to be learned. To be willing to work diligently and safely until a task is completed can be an additional affective value. These and other examples of attitudinal growth are of utmost importance to be mastered for future use and/or adaptation.

Getting the ESIA program started

An industrial arts teacher may be asking the question, "Where do I begin when considering a program of elementary school industrial arts (ESIA)?" This situation can be quite perplexing for those individuals who have not had collegiate preparation in this area. On the other hand, there are some positive actions that one might undertake to initiate bridges of understanding and a meaningful program in industrial arts for grades K-6.

The industrial arts teacher should become aware of the philosophies and values of ESIA. This goal can be reached in several ways. One approach that is often utilized is to visit and observe an operating ESIA program. If possible, plan to spend more than just several hours observing these experienced teachers. Be sure to provide enough time to become fully aware of the curriculum and planned activities to achieve the intended objectives as well as to see the teaching techniques when working with elementary teachers and students.

The second type of assistance is through the use of printed materials which are presently available from various commercial publishers and the American Council for Elementary School Industrial Arts (ACESIA). The monographs published by ACESIA should be an excellent source.

The problem of understanding the growth of young children and how this affects the selection of classroom activities is of utmost importance to all teachers. In the past, some industrial arts teachers have attempted to "water-down" high school projects for use in grades K-6. These persons have made the assumption that curriculum development is best achieved by miniaturizing previously successful efforts. An example of this narrow form of planning would find construction of a small table lamp, while the elementary child would be expected to make a "micro" table lamp. One should keep in mind that such an illustration is not offered as a criticism for making table lamps, but rather as an examination of the direction of thinking utilized and its threat to creativity. In searching for a replacement to the miniturizing approach, it is suggested that one very important element on the selection of ESIA acativities is the "ever expanding arc of awareness." This arc which indicates the child's levels of mental and physical awareness, is present at birth and continues to expand for most adults throughout their entire lives. In an examination of this situation, we find that as the child develops his awareness of the social and physical environments, it is of a circular description. During the first several months the experiences of a young baby are restricted to the length of his arms and legs. The child's awareness continues to expand until he encounters the boundaries of his playing area and all members of the family (prior to 18 months), the neighborhood and

family friends (prior to five or six years) and finally, the nation and its relationship th the world community (prior to ten or eleven years).

While this pattern of development has often been used by the elementary classroom instructor for making curriculum decisions, the industrial arts teacher should examine this method for industrial arts purposes. For example, a project that introduces South American culture to primary-level students would probably not be as effective as a wooden top which would reinforce the skill of counting when used by the child at school or in the home. Therefore, it is not just a problem of what the industrial arts instructor selects but also the element of timing that must be considered. A review of the textbooks that are presently being employed within the classroom would be an excellent place to begin an investigation of what might be most appropriate for a particular grade level.

The industrial arts teacher should identify a time period when a conveniently-located laboratory space is available prior to attempting the first efforts in ESIA. These initial lessons should utilize several 45 to 60-minute sessions (considering the interest levels of young children). There should also be a concern for matching these students with the proper tools, materials, and equipment. More specifically, this would involve the use of seven-ounce hammers rather than 16-ounce, soft pine wood instead of oak ot maple and 24-inch workbenches rather than the adult height of 32 inches. Small groups of intermediate-level students (eight to 12) would also be advised at this time. These children are able to take directions, understand an abstract concept (if properly illustrated) and will not tire as easily as ones from the primary grades. After several successful sessions with the older students, the industrial arts teacher may wish to develop separate lessons for children in grades K-2. Be sure to remember that these younger children are only able to consider objects in view or form actual past experiences. As described, the physical capabilities are also limited in various ways and an awareness of these conditions is necessary for effective instruction.

At this point, the industrial arts teacher may wish to expand the involvement into the actual elementary classroom where the method or correlated approach to ESIA is best achieved. The use of team teaching is also a possibility where two professionals are now able to reinforce each other's efforts. While there are obvious advantages to a correlated program, there are some additional problems to be solved prior to the actual lesson. First, the industrial arts teacher is usually not aware of the practices used by the elementary instructor. These can usually be identified through discussions and observations. In short, the more these two persons know about each other's teaching techniques, the stronger this team effort will be. Secondly, the elementary teacher needs to understand the educational relationships of industrial arts and general eduaction. These discussions should include but go beyond the making of useful objects, developing hand-and-eye coordination and providing the students with a break form their normal schedule. This team of instructors should attempt to provide students with a basic understanding of the technological world and the social and economic roles awaiting them. In summation, an elementary curriculum without industrial arts is simply not a total educational program.

These classroom teachers also need to know about the actual physical activities. Many of them never experience such a program, thus visions of

young children operating large and dangerous power equipment might come to mind. One method of illustrating this situation is by presenting a series of photographs of 35mm slides of the previous lessons in the separate laboratory setting. In this manner, the relatively safe conditions and acts to be used in the upcoming lessons could be illustrated. One additional step in this relationship with a small group of elementary teachers (one to a maximum of four teachers for pilot program purposes), would be to conduct an in-service workshop before the actual classroom sessions. Here the industrial arts teacher will be able to provide instruction and opportunity to practice the intended psychomotor skills. When the appropriate time arrives, these elementary teachers will be more than just aware of what is to take place, but will also be able to assist in the planned instruction.

Conclusion

The key to whether or not an ESIA program is an asset to the elementary curriculum will be the involved teachers', parents' and administrators' basic awareness of its educational values and benefits. In this area of acceptance, the industrial arts teacher or consultant has a major role to play in building bridges of understanding and support. In this manner, each child enrolled in grades K-6 will continue to experience reinforcing activities using tools and materials. Learning will once again be both meaningful and enjoyable for these young students.

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The Role of Administration

by

T. Gardner Boyd and Richard Brown

The role of the administrator is a very important facet of an elementary industrial arts program. The leadership that the administration can provide helps to determine to a great extent the success of the program. The superintendent, industrial arts consultant, principal, and other curriculum area consultants must all agree upon a common ground for incorporation and operation of an elementary industrial arts program in order to support and sell the concept to the school board. The board must then give the program its full financial support. The total and equal support and involvement from all of these persons are necessary to implement and maintain an elementary school industrial arts program. School administrators, supervisors, and consultants serve as the planners and providers of materials, equipments, supplies, and space. These people should work closely with personnel involved, starting with the selection of qualified teachers, and providing in-service training. Administrators of industrial arts programs must be cognizant of the necessary pre-service and in-service preparation needed for a succesful program.

The administrators must show enthusiasm and interest which will support the teachers. Budget and resources which will enable the classroom teacher to carry on the industrial arts activities must also be made available.

The Base of Support

The key to the successful implementation of a program will depend upon the philosophy, objectives, organization, and effectiveness of the personnel who are responsible for its operation. The school principal and the classroom teacher at the operating level are the people who make the program function. Larger school districts generally employ an industrial arts consultant, but, in the smaller school systems, the burden of success is more dependent upon each individual school unit.

The principal, in the role of administrator of the school, is one of the keys to a successful elementary industrial arts program. Ideally the teachers will see the principal as an instructional partner and a supportive colleague. The principal must believe in and understand the importance of industrial arts activities and the value students derive from having the "hands-on" experiences if the program is to become a fully supported integral part of the curriculum. The principal has the responsibility for promoting and assisting classroom teachers with the development of a planned curriculum, continuity, and articulation of the program from one grade to the next. The principal should provide leadership and support for these activities by doing the following:

—Conduct meetings to acquaint the staff with the program.

—Provide workshops to teach the staff how to correlate the industrial arts activities with the subject matter units being taught .

—Organize workshops that give the teachers experiences in using the tools and working with the various kinds of materials.

—Provide assistance in setting up a center where shop activities can be conducted (classroom or special room).
—Assist teachers in the development of curriculum materials and in the scheduling of industrial arts activities.

Providing Training Opportunities

A very crucial part of a successful elementary industrial arts program is the preparation of the teacher or consultant who is going to be responsible for the operation of the program. Opportunities must be provided for those teachers who are already on the staff to attend workshops or credit courses offered by colleges and universities. Systematic plans should be developed so teachers can get the training needed to conduct the program. This will help to alleviate possible fears or any reluctance due to any unfamiliarity with elementary industrial arts.

The elementary teacher has a thorough understanding of child development and the curriculum to be taught at this level, and the classroom teacher knows the students and understands the individual differences. This knowledge is very important since the program requires decisions regarding the nature of the activities, the readiness of the children, the timing of the activities, and the assignments which the students can accomplish successfully. In addition to this knowledge, the classroom teachers should also have a basic understanding of the philosophy and objectives of industrial arts and how to integrate industrial arts into the total curriculum. Skills in the use of tools, materials, and processes will probably have to be learned and developed. Local school districts or teacher education institutions can provide well planned experiences which will assist in the preparation of those planning to enter this kind of a program. Essential components of any training program should include the following, (Hoots, 1971):

1. **The Development of a Philosophical Base.** The success of any educational program is dependent upon the philosophy of those who are responsible for organizing and conducting the program. Pre-service and in-service programs should assist in developing an understanding of the uniqueness of industrial arts and the elements it provides which can enhance the elementary school learning process.
2. **Technological Content.** Teachers of elementary industrial arts need to have a fundamental background of knowledge about technology from which the content for industrial arts is derived. The integration of this content with the elementary curriculum must be investigated to determine what is appropriate for each grade level. Since emphasis is placed on the manipulative methods of teaching, the teacher must be able to select the activities which will provide the best learning experience.
3. **Tool and Material Experience.** This is the most important component for teachers of elementary industrial arts. Experiences with tools and materials will help them develop the necessary skills and level of confidence needed to feel comfortable working with tools

and materials. This phase of teacher preparation should also develop an understanding of the broad range of tools and materials so it can be determined what children at various stages of development can use safely and successfully.

4. **Environment for Learning.** The environment is very important and should be one in which children can participate freely in formal and informal learning arrangements. Each classroom must provide for the multitude of ways in which children learn and for various rates of maturation. Teacher preparation should include lessons which deal with room arrangements including modification of existing classrooms and special rooms.
5. **Opportunity to Try Out Ideas With Children.** Prospective teachers of an elementary industrial arts program should have the opportunity to work with children in live situations to obtain the insights needed to successfully plan and operate this program. Visits to programs in operation for observation purposes are also helpful. This provides a chance to see a variety of organizations, plans, teaching methods, and facilities. An opportunity to apply the theory which has been learned in a controlled learning environment under the supervision of the instructor or a master teacher assists greatly in assuring the success in an elementary industrial arts program.
6 **Involvement of Resource Persons.** The use of resource persons can enhance the teacher training program. A pre-service and in-service instructional program should acquaint teachers with the ways that resource people can be incorporated into the program.
7. **Involvement of Community Resources: Physical and Human.** Since the education of children at the elementary level should extend beyond the confines of the school, teachers should understand how community resources can be utilized effectively in the program. The teacher education program should show how community resources provide effective learning and also strengthen the relationship between the school and the community.
8. **Techniques for Gaining Administrative Involvement.** The elementary industrial arts personnel must possess a background of knowledge and techniques that will enable necessary support to be obtained from administrators and board members. Pre-service and in-service education should include instruction that will assist in informing these people about the purposes, the functions, the content, the contributions, the potential, the problems, and the costs of elementary industrial arts programs.
9. **Program Evaluation.** An essential part of any educational endeavor is an effective evaluation design. Elementary industrial arts personnel should receive instruction in techniques for developing objective evaluative criteria and the procedure for using these in the classroom. Valid evaluation data that shows significant positive results provide a powerful technique in gaining support from the community, administrators, and board members.

Use of Facilities and Equipment

Many school districts conduct effective elementary industrial arts programs in the regular classroom. Regardless of the extent or type of facility, the requirements of the program and the basic facilities for implementing an elementary industrial arts program must be decided upon and planned prior to any needed construction or remodeling. This facility planning must be preceded by careful curriculum development. Although the facility alone cannot insure high level instruction, the quality of teaching is affected by the physical facilities in which the learning takes place and maximum learning cannot occur without adequate facilities. It is the responsibility of the administration to obtain the most appropriate facilities, equipment, and tools in support of the elementary industrial arts program.

Factors to consider when planning facilities should be based upon:

1. Objectives of the program.
2. Course content.
3. Number of students.
4. Grade level.
5. Size and location of laboratory.
6. Percent of utilization of facilities.
7. Storage areas and types of storage.
8. Safety factors.
9. Funds available.

A suitable work area is a must for any satisfactory elementary industrial arts program. Some suggested possibilities are:

1. An area of the regular classroom set aside for industrial arts activities.
2. A special room adjoining the classroom.
3. A laboratory or workroom reserved exclusively for elementary industrial arts activities.
4. A specially designed mobile unit for industrial arts equipment that can be moved from room to room.

In addition to adequate lighting, electrical and other utilities, proper ventilation, and safety exits, there are other requirements essential for the elementary industrial arts laboratory. These need to be examined in view of local requirements.

Public Relations

Public relations for the elementary industrial arts program is the responsibility of school administrators, industrial arts consultant, classroom teachers, parents, and students. The success of the program depends, in part, on good communications and promotional activities. A good public relations program should be well planned and done with a purpose. This should include:

—Meetings to inform the community about the program and its accomplishments.

—Preparation of films, slides, and displays which can be used for meetings with the board of education, P.T.A., civic organizations, and open houses.

—Written articles for the news media and a newsletter for the school community.

—Development of a rapport with the business and industrial community leaders to obtain support—this can be a source of speakers and field trips.

Students involved in the program can be the best ambassadors when it comes to selling the program. Pictures of students involved in industrial arts activities should be used in all of the public relations activities. Displays in shopping centers and department stores with students manning the booth and engaging in the activities are most effective.

Conclusion

A successful elementary industrial arts program must have the support of all personnel involved. The role of the administration is crucial to the success of the program. Without administrative support the elementary industrial arts program will have difficulty succeeding. Unless the administrators of the school system understand the philosophy and objectives of the program it will probably not be implemented or it will flounder, and when budget cuts become necessary elementary industrial arts will not have a high priority.

Since most administrators have had little if any experience with elementary industrial arts in their schooling it becomes necessary for those who see the value of the program to sell them on the concepts and help them to understand its value for young people in the educational process at the elementary level.

When administrators believe in the ESIA program, it is more likely that it can be sold to the community and that financial support will be provided.

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Incorporating Industrial Arts Into the Elementary Classroom

by

Norma Miller

Do objectives for the classroom include ways to stimulate students to participate in problem-solving situations that are meaningful, to apply the skills learned in the various subject areas to solve practical problems, and to exude excitement and enthusiasm for learning?

While planning a unit on the development of man's technology for two sixth grade classes, the activities that evolved not only met the above criteria by actively involving the students in a study of industrial arts, but also motivated the teacher to become as excited about teaching as the students were about learning.

Neither the author nor the team-teaching partner were industrial arts teachers. Nor were there any special training, facilities, tools. or materials available for this project. All that was present were sixth graders in a standard size classroom with a small cafeteria available for use on a part-time basis, a combined total of thirty-plus years of experience in the intermediate grades, a very co-operative principal and supervisor, and a willingness to try an idea that was thought to be worthwhile.

Although the acivities described in this section required large blocks of time over an entire school year and correlated many phases of the curriculum, this need not be restrictive in terms of developing one's own program. The wealth of possible activities and the many mediums comprising the experiences are so varied that industrial arts could be incorporated into the curriculum of any grade level for any length of time with any amount of resources readily available to the classroom teacher. Correlation with elementary subject matter could range from a single activity to enhance a concept being taught to a major project around which much of the curriculum is centered.

The intent of this section, therefore, is not for replication, but rather for sharing the procedures followed in developing a program. For ideas concerning other possible activities and how to implement them, an invaluable source of reference is **Teaching Children About Technology** by Mary-Margaret Scobey, McKnight and McKnight Publishing Company.

The acivities in this program were divided into two parts, each requiring approximately one semester. Those in the first semester focused on providing a background of understandings and skills. Those in the second semester provided for the application and augmentation of the understandings and skills in order to solve the problems involved in mass-producing items to sell.

The initial step in planning the first semester's work involved ascertaining the understandings to be achieved by the students, determining the ac-

tivities to attain the understandings, and identifying the skills required to carry-out the activities. The following were selected:

Understandings:

—Man has learned to use tools, machines, and energies to change the raw materials of his needs and desires.

—Doing so has afforded him control over his natural environment, has changed his ways of living, and has changed his environment.

Activities:

—Trace the development of man's technology through the discovery and use of tools, machines, energies, and materials from stone-age man to modern society.

—Examine how major discoveries of man have affected the amount of control he has had over his environment and have changed his ways of living.

—Examine various facets of our current technological society in terms of how man obtains, prepares, and uses the materials and products of daily life and the problems and benefits of this process.

Skills:

—Locate information

—Read content material

—Take notes from printed materials, audio-visual materials, and recource people.

—Organize and outline information.

—Write reports.

—Report orally.

—Draw conclusions and inferences.

—Make value judgments.

Lessons were taught to systematically develop the above skills using section of social studies and science texts, duplicated materials from books and encyclopedias, and audio-visual materials containing information pertinent to the understandings to be developed.

Involvement in Research

The students used the information to develop a timeline on which the major discoveries of mankind were placed with statements concerning how each discovery changed man's way of life. The timeline served not only to consolidate many of the major ideas studies and to provide the students with a feeling for the time that had elapsed since mankind's inception, but also emphasized the acceleration of our technological society during the past 100-150 years.

Once the majority of the students had attained a level of skill development suitable for independent research, individuals and small groups did extensive research on topics concerning our present technological society and reported the finding to the remainder of the calss. Since the subject of technology provided such a variety of topics, each student was able to choose a topic of interest at a level commensurate with abilities. Listed

below are sample categories of topics from which students chose specific report topics, such as those lised in parentheses:

—Power Sources (electricity, atomic energy, solar energy, geothermal energy, natural gas, petroleum, coal, kinds of engines).

—Construction Materials (stone, clay, wood, metals, glass, plastics, rubber).

—Food Production and Processing (fruits, vegetables, grains, meats, fish, dairy products, beverages).

—Textiles and Clothing (animal fibers, plant fibers, synthetic fibers, leathers).

—Transportation (motor vehicles, railroads, water craft, aircraft, spacecraft).

—Communications (graphic, electronic).

Minimum requirements were established for each report to include information relating to the following questions:

—What raw materials are required for the production of the product and how are these obtained?

—What processes are followed to change the raw materials into the product?

—How is the product used?

—What problems are caused by the production of the product and what is being done to try to solve these?

In addition to the written reports, the students were expected to do as many of the following activities as possible:

—Write letters to industries related to the topics requesting information and display materials.

—Arrange displays of materials received, actual items, or pictures of items to illustrate raw materials used, products produced, or uses of products.

—Make flow charts using a graphic form to show the steps followed during production.

—Make scrapbooks of newspaper and magazine articles and handwritten summaries of television/radio reports concerning their topics.

—Arrange a visit to a place or an interview with a person involved in a type of production related to the topics.

Each student was required to report the findings to the remainder of the class using the displays, charts, and other materials as visual aids.,

Overall, the students prepared excellent reports and presentations, many basing their reports on information gathered through interviews and visits to such places as local factories, a power plant, and a solar-heated home as well as information gathered from books. It is interesting to note that several of those who took the initiative to gather such first-hand information were ones who were not considered to be the "good" students.

By the beginning of the second semester the students had achieved the basic general understandings and skills related to the objectives. The time

had come to involve the students in specific situations which would require the application of these skills and understandings in some concrete, productive forms.

The classes were divided into two companies. One was to work with wood, the other with ceramics. The choice of wood and ceramics was simply based on the access to borrowed wood-working tools and ceramic molds, to a kiln, to the availability of materials, and on the limited experience of the teachers with these materials. (The local businesses are very willing to advise teachers on how to work with the materials they sell.)

A main goal of this phase of the unit was to provide experience that would encourage the students to discover a process for solving problems and to provide many opportunities for practicing the process.

Recognizing Problem Solving As A Significant Part of Production

To introduce problem solving, the suggestion of forming companies to mass produce wood and ceramic products to sell was introduced for student response. the students were encourage to identify possible problems that might be encountered. Each problem was listed on a chart in random order as it was suggested. Through class discussion concerning how the many problems could be solved, it was decided that the problems would have to be categorized according to topics and ranked in order according to what would have to be solved first, second, and so on. Further discussions accomplished these tasks, and the problems were again charted. Although the students did recognize most of the major problem areas at the outset, others arose during the course of the project. These were then discussed and charted. The completed list was approximately as follows:

I. Organization
   - A. How should the companies be organized?
     1. What jobs will need to be done?
     2. What positions will be needed to do the jobs?
     3. What responsibilities should accompany each position?
     4. How should people be selected to fill positions?
   - B. What should be produced?
     1. How can it be determined what is marketable?
     2. What tools and materials are available?
     3. What skills do workers possess or can learn?
     4. What limitations need to be considered in terms of time, space, cost?
   - C. How can the companies be financed?
     1. What steps will be necessary to determine how much money will be needed?
     2. How could shares of stock be sold?
     3. How could money be borrowed?
     4. Who will take care of the money?
     5. What records will be needed to account for income and expenses?

D. What tools will be needed?
   1. How can the types of tools needed be determined?
   2. From where can needed tools be obtained?
   3. How can the proper use and care of the tools be learned?
   4. Where and how can the tools be stored when not in use?

E. What materials will be needed?
   1. How can the types and amounts of materials needed be decided?
   2. What factors should be considered when purchasing materials?
   3. How can the proper use and care of materials be learned?
   4. Where and how should the materials be stored?

II. Production

A. How can the item be produced in the quickest and most efficient way?
   1. How can the number and sequence of operations needed to complete the product be determined?
   2. How can the number of people necessary for each step be determined?
   3. How should people be selected to work at the various steps?
   4. What knowledge will be necessary for the people at each step and how will this be learned?

B. How can the assembly line be organized to assure a continuous and smooth flow of work?
   1. How can the space available be used to establish the most efficient flow of work?
   2. How can the time required to complete each step be organized to permit the continuous progression of the product along the line?
   3. What tools and materials will be necessary for each step?
   4. How will the product be moved from one station to another along the line?

C. How can the quality of the product be maintained?
   1. At what points along the line should there be inspection stations?
   2. What criteria should be established for inspection?
   3. How should defects be handled?

D. How and where should finished products be stored?

III Marketing

A. What factors should be considered in establishing the price of the final product?
   1. How can the cost of the materials required for each product be determined?
   2. How can the cost of labor per product be determined?
   3. How can the cost of the money borrowed be determined per product?

4. What percentage of profit can be made and still sell the product at a reasonable price?

B. How can the product be advertised?
   1. What are the basic techniques used in advertising and which of these could be used to sell the product?
   2. Who will be responsible for advertising the product?
   3. What materials will be needed for advertising and what factors should be considered in selecting them?

C. How can the sales of the product best be managed?
   1. When and where will the products be sold?
   2. Who will be responsible for selling them?
   3. What records will be necessary for recording sales information and for providing receipts?

D. How will the profits, if any, from the sales be calculated and dispersed?
   1. How can the profits be determined?
   2. How should the profits be used?
   3. How can the dividends per share be calculated?

Throughout the discussion of the problems involved in organizing the companies, the students were asked to list alternatives for each problem discussed. Each alternative was examined in terms of advantages and disadvantages until a solution was determined. The need for future evaluation of decisions was discussed.

After guiding the class through these steps several times, the students were asked to identify the steps which had been followed in order to solve the problems up to that point. The following steps were elicited: identify the problem, offer the alternatives, consider factors affecting each atlernative, choose a solution, and evaluate the solution after it has been implemented.

Student logs were the prepared for each student to maintain throughout ensuring discussions. The logs delineated the steps in the problem solving as follows:

Problem	Alternatives	Considerations	Solutions	Evaluation

The logs were filled in by the students following each discussion of a major problem. By the time the company officers were elected, the officers and company members could follow the process with very little intervention on the part of the teacher as discussions of problems were continued from the outline. Each student was responsible for maintaining his log throughout the project.

Following this procedure, the teacher's role is primarily one of guidance. Probably the most difficult part for the teacher is refraining from

"telling" the students what to do rather than allowing them to discover how to solve the problems themselves.

Many of the problems the students had to solve required some type of research, either from written materials, audio-visual materials, or from resource people in the community some involved research activities by all of the members of the companies; others were delegated to committees or individuals.

Organizing Personnel

The first step in organizing the companies was the selection of officers. The students listed the jobs which should be handled by officers and grouped these into categories. From the categories the need was established for the following officers for each company: President, Vice-President of Marketing, Secretary, and Treasurer. The students then wrote job descriptions listing the responsibilities for each office. Both companies decided to hold elections to fill the positions and proceeded with nominations and voting.

Selecting the Product

To determine what wood or ceramic items to produce, the students of each company studied catalogs picturing sample items and made suggestions based on their own experience. Each suggestion was discussed in terms of size, materials, time, skilled involved, and cost until a list of approximately a dozen possible items was formed by each company. This list was duplicated and each students interviewed at least three prospective customers to determine the items that people might be interested in purchasing. The results from these "consumer surveys" were then tabulated to determine what to produce. The wood company decided to make napkin holders and note holders. The ceramic company decided on flower pots, bud vases, candle holders, banks, and small figurines to put in planters.

Financing the Venture

To finance the companies, the students decided to sell shares of stock for $1.00 to company members only. They also arranged a loan, with interest, from the school under the condition that the money would be available if they needed it. As it turned out, that money was not needed. Groups of students designed the stock certificates and the forms needed to record financial transactions. The treasurer of each company collected and kept records of all company money. (A student booklet from Junior Achievement was helpful in aiding the students in designing the forms.)

Determing Tools and Materials

In order to determine what tools and materials were going to be needed and how production was going to be organized, the students decided to make prototypes of each item to be produced. These were made by the company officers under the close supervision of a teacher. (The team teaching situation was ideal for doing this as one teacher could be supervising the group making the prototypes while the other was working with the re-

mainder of the students who were involved in a related activity, such as researching the materials and tools to be used.)

Organizing Resources and Systems

The prototypes were invaluable. The students used them to estimate the type, amount, and cost of materials to be used. These were also used to establish what jobs would be required to mass produce the items and the order in which the jobs would have to be done. Once this was established, the students decided on the work stations that would be necessary to do the jobs and on the number of workers, the tools, and the materials needed at each station. The work space available to accommodate the stations was arranged, and it was determined how to move materials and products to and from the stations.

The wood company decided to form an assembly line with each station along the line performing certain functions, such as cutting, sanding, assembling, staining, and varnishing. The ceramics company decided to establish a piece-work procedure in which each student would pour slip (liquid clay) into a mold. Then the student would clean pieces that had been poured the previous day or would apply glaze to pieces that had been fired. After the slip had "set up," the worker would remove the excess from the mold. When it was sufficiently hardened, the student would remove it.

The various jobs were assigned by the officers. However, during later evaluation periods, the students decided that it would have been better to have had applications for each job and to have awarded the jobs according to the abilities of the workers as demonstrated during job interviews. Also, the companies decided to "pay" the workers and shareholders by dividing up 50% of the profits among shareholders and 50% of the profits among all the students comprising the company. During later evaluations the students decided that it would have been better to pay the officers a percentage of the profits as salary, to pay the workers of the wood company by the hour, and to pay the workers of the ceramic company by the number of pieces properly finished.

It was decided that the above measures would have provided for more consistency in the quality of the products, for less waste of materials due to errors, and for elimination of any "goofing-off." Very few discipline problems occurred, and those that did were handled by the company officers with a teacher present. Usually the punishment consisted of the offender being removed from his job for a period of time or being required to stay in at recess to correct the error.

Although an attempt was made to refrain from overly directing the activities in this project, the teachers did take a very active part in teaching the students how to use and care for the tools and materials and in supervising the work closely. The only piece of power equipment used was an electric drill and that was used only in a teacher's presence. Also, the students in the wood company wore safety goggles at all times.

Keeping Records

Records were kept of all financial transactions and of the hours worked throughout the project. When production was finished, these were used to ascertain the costs of materials and to estimate the costs of time and personnel per item. Once the total costs were established, the amount of profit was calculated and the selling price of each item was determined.

Advertising Techniques

The students had previously studied types of advertising techniques in a language arts unit. What had been learned was applied to formulate an advertising campaign involving posters, notices sent home with students in the school, announcements over the public address system, and an article in the local newspaper. All students were involved in this phase of the project.

Experience in Sales

The items were sold at a PTA meeting with any of the students able to attend working assigned shifts to sell the items, make change, and record sales. The profits were divided among the students with each receiving between $3.55 and $5.65 depending on whether the student was a shareholder in the company for which he worked.

Conclusions

Overall, the students showed surprisingly good judgment in making decisions and in doing the work. However, not everything went smoothly all the time. For example, the wood company had some difficulty arranging the assembly line so that all workers were consistently busy. Since some steps required more time than others, the line had to be reorganized several times to establish a constant flow of work. Solving problems such as this provided excellent learning experiences.

Much learning occurred. Complex concepts such as the interdependence of man to practical matters were understood as students experienced settling differences of opinion. As is evident from the types of activities described, the students had to apply skills learned in all phases of the curriculum in order to solve the problems which occurred.

It was felt that the students learned more, worked harder, and showed more enthusiasm for learning during the project than in any other project or activity the author has ever attempted. Even though such an undertaking demands much time and work from the teacher, it seemed that the rewards for all the participants were very great.

Integrating Industrial Arts Into the Elementary School Program

by

Wesley Perusek

This chapter begins with several assumptions. It is assumed that the school system offering industrial arts experiences for children has done so deliberately. Goals are established to indicate that the system and community value the contributions of such a program and the experiences and related opportunities it provides children.

A second assumption is that the school system's leadership displays confidence in the ability of its teachers to organize and plan work in accordance with the needs of the children in a given year. It follows also, that teachers are given support, encouragement, time, and material assistance to create their own program based upon these needs.

Another assumption is that an active process of education is encouraged in which children are not sitting much of the day but are working and learning from each other, and from materials of wide choice and diversity which are both commercial and locally made. Group activities are encouraged, and rewards are accrued to the group at the same time that individual initiative and work are recognized. In such a setting, incorrect language forms are accepted as children make discoveries and explore new ideas.

A fourth assumption is that teachers will be encouraged to work beyond textbooks, workbooks, and reference materials - all largely print oriented - and will initiate studies and activities growing out of shared experiences and the lives of the children, the school, and the community. Closely following the above assumption is that schools will actively seek a broad base of equipment and supplies and develop easy methods for teachers to obtain added items as interests and needs develop.

Further, it is assumed that for the elementary school, there are approximations of a hierarchy of knowledge, technology, and subject areas. Teachers working together with their administrators, parents, and children will develop their own goals and program. This program will be appropriate to the school population and reflect the community's viewpoint.

Finally, it is assumed that the conception of education involves a leading out as well as the development of acts and skills. Children will be free to explore their environment. Teachers will be free to go beyond "the textbook" or "the package." Teachers will have opportunities and conditions appropriate to exploring and developing their own use of materials, tools, and technology.

None of these conditions or assumptions is new. Good teachers and schools actively encourage them. Where they are encouraged, one will likely find a ready and eager acceptance of the kinds of experiences that industrial arts opens to children.

Organizing Diversity

Where wide variety exists in any group of children or where they are grouped heterogeniously, large group instruction is very difficult. Under these conditions, schools experiment with various schemes for grouping children. Even so, wide ranges still exist in ability, interests, and learning style. Means for self-instructional materials and wide options become necessary.

Some schemes for organizing such diversity simply move children in small groups from area to area within the classroom. Worksheets or dittoed assignment sheets direct the action, and the clock controls the sequence. Such a scheme does move away from the teacher-up-front-all-the-time to a slightly less formal approach.

In other classrooms, the environment and style encourage children to use materials and work independently or in small groups throughout the day. The teacher is contacted at certain times for specific work assignments or help. The materials in such classrooms must absorb the child or group of children for an extended time with little or no teacher help. The teacher sets the pattern of work and ensures that assignments are completed. The pattern might be for a day, several days, a week or several weeks, and require a certain amount of work. Such classrooms use learning centers, stations or interest centers with materials, apparatus, charts, reference materials, and tools at the center or station. At the station are task cards or work cards which ask or direct certain aspects of the work area. When teacher made, these cards are a means to individualize the work. Various schemes are evident for coding such cards, perhaps by difficulty or by area or topic with number, letter, or color.

Children maintain their own records of accomplishment in notebooks, logs or assignment books. Some task card work may be assigned, some may be self-selected, or a combination of assigned cards and self-chosen cards may be appropriate. Records in such a scheme are necessary. Therefore, children need to know what scheme is used in order to know how to record and report their work.

Teacher records, too, are essential in this scheme. Often, anecdotal notes on each child, entered daily, help the teacher record progress. Some teachers use a weekly chart showing work required of all and work which may be elected by all. Children and teacher come together for only a part of each day as a whole class. Much of the time is devoted to individual and small group work.

With this background, some typical learning activities can be examined. These are the ways teachers organize activities and work and accomplish integrated learning experiences for children utilizing technology and industrial arts.

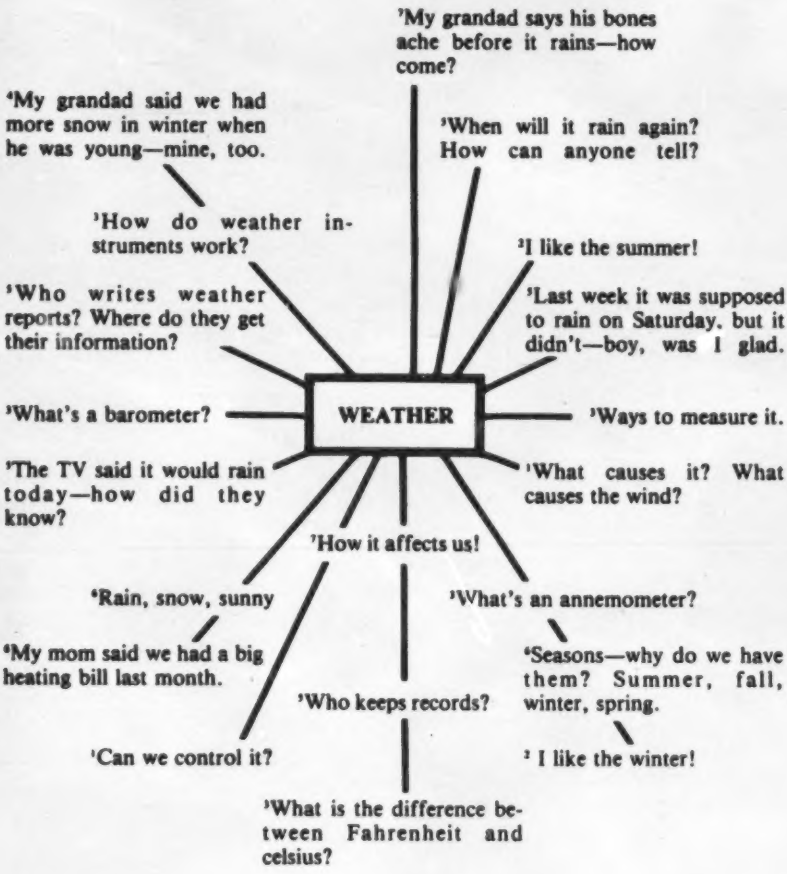
Organizing Activities

Broadly, wherever a material or first-hand experience will enhance or enlarge a topic, unit of work, or theme is the appropriate place to use it. As an example, science experiences with weather suggest constructing or housing weather instruments; visiting a weather station; collecting and recording

local weather reports in newspapers; setting up a weather monitor in the classroom to keep track of the National Oceanic and Atmospheric Administrations (NOAA) weather broadcasts; checking into local agricultural conditions to find out why certain crops are grown; or investigating nearby waterways to find out how they operate in the total water system in the area. These and many more are examples of the type of practical experience to be easily undertaken in any elementary classroom without a great deal of expense or equipment.

They all often begin with questions children raise. They suggest things to find out. It is surely far more effective to find out from beginning ques-

WEATHER EXAMPLE—IDEA SUNBURST OR CURRICULUM WEB—ROUGH


'My grandad says his bones ache before it rains—how come?
'My grandad said we had more snow in winter when he was young—mine, too.
'When will it rain again? How can anyone tell?
'How do weather instruments work?
'I like the summer!
'Who writes weather reports? Where do they get their information?
'Last week it was supposed to rain on Saturday, but it didn't—boy, was I glad.
'What's a barometer?
WEATHER
'Ways to measure it.
'The TV said it would rain today—how did they know?
'What causes it? What causes the wind?
'How it affects us!
'Rain, snow, sunny
'What's an annemometer?
'My mom said we had a big heating bill last month.
'Seasons—why do we have them? Summer, fall, winter, spring.
'Who keeps records?
'Can we control it?
'I like the winter!
'What is the difference between Fahrenheit and celsius?

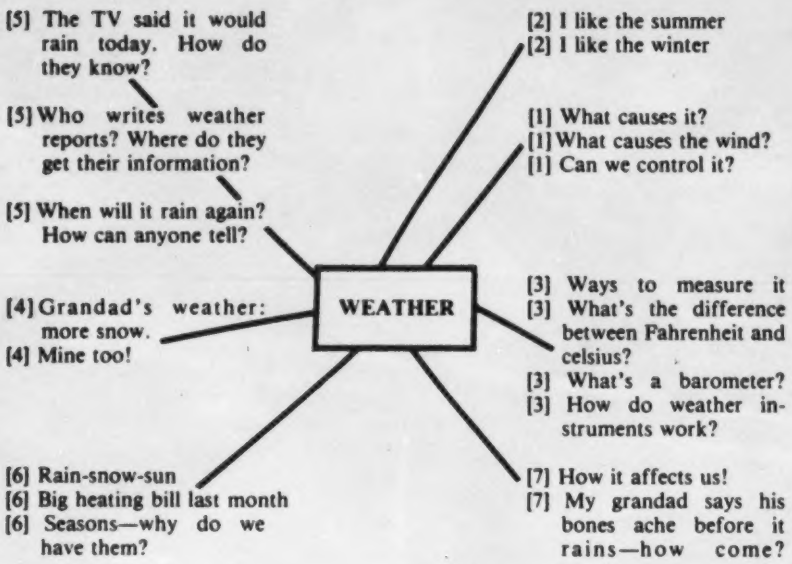
tions and curiosity than simply to read about a topic, answer a few questions, and go on to another topic. This is the essence and the value that real experience through the inclusion of an elementary industrial arts emphasis brings to education in these early years.

This process emphasizes discovery, experimentation, problem solving, group cooperation, construction, planning, reading, writing and illustrating, measurement, record keeping, accuracy, model building, observation, work, and the rewards of completing a task or experiment and gathering results and sharing them.

The Idea Sunburst—Curriculum Webbing

Before the class begins this study, it is useful to plan. One way this has been done with high success is the use of brainstorming developed into a curriculum web or idea sunburst. This is a schematic planning device on which teacher and children plan together. It begins simply with everyone gathered around a large chalkboard or sheet of paper. At the center is listed the topic; in this case, weather. Using such questions as: "What do we want to find out?" "What do we know?", or "How can we do it?" raised by the children or teacher, the teacher or group leader begins building one word or short phrases or sentence entries around the center copic. Soon, the idea sunburst radiates in many directions.

WEATHER EXAMPLE—IDEA SUNBURST OR CURRICULUM WEB—1st REVISION


[5] The TV said it would rain today. How do they know?
[5] Who writes weather reports? Where do they get their information?
[5] When will it rain again? How can anyone tell?
[4] Grandad's weather: more snow.
[4] Mine too!
[6] Rain-snow-sun
[6] Big heating bill last month
[6] Seasons—why do we have them?
WEATHER
[2] I like the summer
[2] I like the winter
[1] What causes it?
[1] What causes the wind?
[1] Can we control it?
[3] Ways to measure it
[3] What's the difference between Fahrenheit and celsius?
[3] What's a barometer?
[3] How do weather instruments work?
[7] How it affects us!
[7] My grandad says his bones ache before it rains—how come?

So the idea is off and running. Interest is building. Enthusiasm is evident. Real questions are being asked and no-one, teacher included, has the answers. When the ideas and questions have seemed to peak, it is time to regroup. Simple questions lead this. "What goes together?", "What is like something else?", "Would this be more appropriate here or there?" As answers begin to be formulated, the teacher or leader places a new blank sheet or board in front of the group to rebuild the ideas with the first trial visible to everyone. Similarities are grouped together by number or letter. This is a judgement to be made on the spot.

At this point, the idea sunburst can be placed on the wall and the teacher can ask: "Who would like to find out about or gather some information on each topic and share it with us? You can team up if you like." Some regroupings are often necessary. For example, what to do with [2] I like winter, I like summer? Here, the statements can be rephrased: "What affects our season?", What activities go on in each season?", "What problems are created in any season and how do we solve them?" When it is not possible to regroup or rephrase a statement, it can be set aside until later. "We didn't see how that fit then, but look now!"

Children's names can then be entered on the sunburst, leaders chosen by the group, and the work is underway. Time lines can be developed, and a general plan of work can begin. Responsibilities for reporting back to the group should be made clear.

Although like a contract method or experience chart, the idea sunburst draws out children's ideas and questions and organizes work around them. The teacher, too, can add questions to each group: "Did you think about _____?", "Another point here might be _____." The teacher is being the leader in this process and is offering questions based upon knowledge and experience that help the children enlarge their own thinking and questions.

The idea sunburst can now be placed on a wall above an area where displays, reference, and results of work are located. An interest center is under development.

As children work on this one theme, other themes will emerge. So other idea sunburst will be developed. A classroom of 25-30 children may have five, six, or more investigations going on at one time.

As work is done, new ideas and questions will emerge to be added to each sunburst. The process can continue on as long as interest is evident. It will soon be evident that themes overlap even across separate subject areas. This should be discussed and shared and interrelationships noted and developed.

It is also important to note that this process is meant to be done with children. It is not a plan made in advance and handed to a group or class as an assignment. It is also worth noting that this idea works equally well for adult groups in planning work. It is a way to help the thinking processes and organize work.

The Problem Folder

When work is underway in any area, it is useful to have a way to maintain records and see progress. One way to do this is through the use of pro-

blem folders. These are simply large colorful blank pages. One the cover are questions or topics which follow from the main theme; in this case, weather. The groups formed to seek information on a particular aspect of the main theme also raise questions which can be placed on the cover or first page of the problem folder. The names of the children are also prominently on the cover. The problem folders are used to collect information, drawings, results of experiments, opinion interview results, surveys, newspaper or magazine articles, photographs, and even sample materials. They can be organized by chapter or section and could be in the process of development for several weeks.

When work has reached some conclusion, teachers often assign a library card and number to a folder, with the author's prior permission, and place the folder/book and the card in the school library for reference by other children. Other teachers use the problem folder as a record of achievement when meeting with parents. The folder/book idea can accompany larger projects, models, drawings, and displays and in this way can present a more complete record of work.

One teacher working with gifted/talented children uses this idea in a different way. Children are asked to think about and pose questions and problems and gather data as they think someone else would do it. What questions would be asked by an engineer, a chemist, a computer programmer, or an airline pilot? Results and data are then based upon how the children think the person named would respond. Imagination and resourcefulness are stimulated here in a different way.

Problem/Task or Work Cards

Still a third way to organize work and help individuals is through the use of task or problem cards. This idea is widely used but has its best impact and use when designed and prepared by the teacher. It is found in some commercial sets which accompany apparatus and is geared to the children's level and needs. As the teacher sets the stage for learning, tasks or work cards can be developed to allow every child the opportunity to feel comfortable about doing work in any subject or activity area. Several features about using these cards are:

1. They contain both written and pictorial information.
2. Questions or problems are often open ended, requiring thought, experimentation, and/or collaboration.
3. When assigned, the problems are within the capabilities of the children.
4. Letter, number, or color code help organize cards and work by sequence, concepts, difficulty, or area.
5. Cards are often written to allow children to select their own methods of solving the problem or finding an answer.

Work cards are often located where equipment or materials are found so that collaboration, investigations, experiments, or exercises can proceed without collecting apparatus—then returning it to some storage area. Some

method needs to be developed to keep track of work using cards. Teachers can assign cards by number or letter over a period of time. If the period is a day, children can select their own time when it is best for them to do the work.

Another way to record work is to use student logs. These are blank notebooks with dated entries on assigned work. Teachers can call for these in a way that allows them to check progress and also offers suggestions for further work. The logs can also be used to permit children to write something every day. Feelings, experiences, events, questions, or problems can all be expressed in the log in a diary format. Some teachers use the logs as a two-way communication link between teacher and child.

These, then, the idea sunburst, the problem folder, the work or task card, and the log are four ideas which help create independence and help organize a classroom where a wide variety of work can go on. They are all developmental in that they are not fixed aids or props to the learning process but rather are developed with children to provide guidance, order, and records of the learning process.

It is important to consider materials in the broad sense in the elementary classroom. A recommended publication on selecting and using materials is the Association for Childhood Education International's 1976 publication: **Selecting Educational Equipment and Materials For School and Home.** The authors separate typical industrial arts materials and equipment into: Building and Construction Materials, Creative Arts, Art and Construction, Science, Arts and Crafts and Woodworking and Construction.

Ways of Working

Three most common ways in which teachers and schools work to provide the broadening experiences of industrial arts are:

1. Teacher alone in the self-contained or open classroom who seeks to broaden classroom experiences.
2. Teacher in the self-contained or open classroom who seeks to broaden classroom experiences with an advisor available on call or on a scheduled basis.
3. Teacher, classroom and advisor with a special room available to use on a needs or scheduled basis as a workshop/classroom/laboratory and storage area for rotating supplies and equipment.

Each has advantages and some disadvantages. Let us look at each case with some qualifying conditions and examples.

The most prevalent situation is when the teacher is alone in the classroom. The students and teacher combine together to create meaningful experiences in industrial arts activities. Teacher attitude, preparation, and point of view about tools, noises and continuous mess in the classroom will determine what other or broader experiences will be brought to that classroom. It is assumed that the teacher is seeking broadened classroom ex-

periences and wants the inclusion of a technical tool/materials emphasis. If the attitude is slightly experimental ("let's try it and see") and if the support is evident, many activities and shared experiences are possible. Often, these lead to unexpected events. In one classroom, for example, children brought in aluminum drink cans to build a solar collector. Discussion led to where the cans originate, how many are seen along highways, and efforts to recycle them. This led to considering a recycle center at the school leading to problems of storage and transport. Arrangements with the county brought two storage bins; one for aluminum and one for glass. Total income for one school year—$1,000.00—all of which bought additional classroom materials. Soon, several more schools joined the effort and a significant program of conservation was underway.

For this teacher, as for many working in self-contained classrooms, the need was for follow-up support to a basic idea. The need called out for ideas and help to take an idea beyond thinking and planning to the doing. Discussions, telephone calls, inquiry all become a part of the process. Letters to aluminum and glass manufacturers brought much literature, films on processes, and an invitation to visit the glass plant and research center. In short, the world opened with the interests and initiative generated in one activity. Many similar examples could be cited.

This teacher's classroom was organized with desks grouped to allow three or four children to work together. The equipment included a workbench with hand tools and small parts storage bins, aquarium with fish, a globe, collections of shells, bird's nests, reference materials written and art work displayed, a metric area with tools and charts, several models of the community under construction, a typewriter and a variety of science apparatus and wall posters. The schedule was organized on a block time basis—a typical arrangement:

<table>
<tr><td colspan="3">OPENING AND ANNOUNCEMENTS</td></tr>
<tr><td colspan="3">MATH</td></tr>
<tr><td>SPELLING</td><td colspan="2">LANG. ARTS</td></tr>
<tr><td>MATH
SPELLING</td><td colspan="2">SEPARATE READING
GROUPS</td></tr>
<tr><td colspan="3">LUNCH AND RECESS</td></tr>
<tr><td colspan="3">SCIENCE</td></tr>
<tr><td colspan="3">RECESS</td></tr>
<tr><td colspan="2">SOCIAL STUDIES</td><td>ART</td></tr>
</table>

When the teacher is alone in a self-contained or open classroom and has the services of an industrial arts advisor, much can be done in given periods of time. The class teacher set the tone.

It is important that the advisor spend time at the beginning of the year

in the classroom, talk informally with the teacher, and, where possible, work with the children. In this way the industrial arts teacher is in a position to make a contribution to the entire process.

It will be useful to share teacher plans to find out what resources are at hand and what is needed. It is also useful to share some of the skills, materials, and experiences which can be brought to the classroom. Much give and take is necessary to establish trust and a sense of team spirit and effort.

The importance in sensing the developmental level and needs of the children and the style, methods, and approach of the teacher cannot be over emphasized. Only by making the contributions of industrial arts available on a level which can be accepted or adopted can a successful match be made. The teacher is the best guide here.

Time is needed to plan together. When one advisor serves many teachers, the demands on time can be impossible to meet so that some scheduling may be necessary. This both helps and harms the processes. A schedule fixes activities in time. Interests, however, know no time schedule. Spontaneity can easily turn to routine and routine to disinterest and boredom.

On the other hand, a schedule, if flexible, can assure some definite times for cooperative work. Knowing that certain times are open for the advisor to work with a particular teacher and class suggests planning be organized differently. Where travel is needed between building, much more time or fewer classroom contacts will be made. The advisor, teachers, and school district often find the need for a material-classroom-laboratory-workshop area.

In larger districts, the advisor often sets up a laboratory or center for both teachers and children. Activities can be occurring in both the lab and the classroom. One caution to consider in this appraoch is the separation being created between what goes on in the classroom and what goes on in the lab. If anything in the lab can be and is also used in the classroom and children and teachers know this, little problem results. If however, certain items must remain in the lab and can only be used there, the problem of segregated rather than integrated learning develops. Local conditions often determine how best to use the available space.

Materials-Equipment

In general, it can be said that more and more elementary classrooms are expanding the range of learning materials available to children. Such classrooms are living environments offering more contacts with concrete items. Many of these can create problems of cleanliness and storage.

Styrofoam is messy. Wood makes sawdust, and chips are easily tracked to other areas. Sand and soil easily create dust and mess. Animals in the classroom bring housing, sanitary, and cleanup problems. Water systems for studies of buoyancy, flotation and design of vessels, dams, or river systems also create floods—right in the classroom. An old washing machine or small engine becomes greasy and messy when it is disassembled for discovery purposes. Baking bread, cupcakes, or cookies or making jello, pudding or oriental dishes can create problems.

The point is straight forward. All of these materials and far more with their own properties and associated reality can only be experienced by dealing with them. Much is lost when classrooms divorce themselves from the real world substituting instead symbols for things, too often before the represented things or events have been experienced by the children.

The classroom teacher is the only person who should select classroom material materials. No other adult is in a position to know the children and make the best match between needs of children and the environment in which they work. Because these needs are developmental with different interests which vary with time—even day-to-day, the teacher needs flexibility in purchasing and making materials available. A group studying insects out on a walk through a field may want collection and identification materials or equipment not readily at hand in school supplies. Waiting for a requisition to be processed and all that this entails with catalog suppliers simply defeats spontaneity. Surely, some materials and equipment items will be ordered in advance. However, a good share of classroom funds should be available throughout the year to feed and support unanticipated opportunities.

Flexibility, too, is important in providing classroom materials and equipment. Whole sets of books need not be purchased when only six or seven children will use them at one time.

Several excellent source books are available to help in selecting equipment and materials. Priority can then be given to purchases and to a timeline drawn for all purchases. It is important that teachers have decided how available funds will be spent. It is important that teachers know that their ideas and plans for equipment are shared and felt by all concerned.

Large cost item purchases such as tools, good microscopes, small refrigerator, telescope, binoculars, aquariums, calculators, typewriter, the micro-computer, and sewing machine, for example, might be purchased and moved from classroom to classroom. The cooperative attitude of staff is critical in such a scheme so that exclusionary "dommains" or "turf" problems do not arise.

Teaching Style

Many teachers develop a unique teaching style. Some work in very informal ways with children in individual or small group projects. Others take a highly personalized, idiosyncratic approach to teaching and operate in different ways depending on the children, the topic, or the available environment.

Whatever the background, teachers usually report eagerness to expand the contacts, skills, and knowledges in the area of technology.

Far more work is needed to bridge gaps between early childhood, elementary education, and industrial arts education. Each area has so much to offer the other. Each is serving a classroom of children and teachers multiplied by thousands. In this regard, curriculum development, too, has no single path or approach. It is continually in a state of requiring a continuous process of investigation, experimentation, and application. The best ground for this process to grow is not in a textbook or graduate course, but in the classroom and school with a group of children and their teacher.

Facilities for Elementary School Industrial Arts

by

E. Allen Bame
and
Charles Pinder

Facilities for elementary industrial arts programs can vary from the regular classroom to specialized facilities and equipment. Many factors enter into the selection or designing of facilities. Some of these are the desires of the teachers, program goals, availability of resources and funds, and frequency of student use. Despite the facilities available, elementary industrial arts program's can be conducted in a variety of settings utilizing a variety of methods. Some of the more common types of facilities will be discussed in this section.

Mobile Classroom

In some school systems the mobile classroom has proven to be a workable way to provide industrial arts facilities to several schools. The mobile unit, usually a van or trailer, is moved as the need arises or as established by some schedule from one school to another. This arrangement is usually found in smaller school systems where a full-time teacher can not be provided for each school. Such mobile facilities have also come into use where an extra facility is needed to overcome crowded conditions in a school.

The mobile lab shown has been in operation eleven years in Nelson County, Virginia. The unit is moved among four rural elementary schools providing an environment for students to explore technology. The single teacher is able to work with the teachers and students in all the schools. Ten different constructional work activity areas are provided including: screen printing, ceramics, metal enameling, jewelry making, leather work, and woodwork.

A mobile lab presents special problems due to the fact that provisions must be made to secure all loose items during transit. Tool panels must be equipped with locking doors. The tools must be secured witha tool holders that will prevent the tools from coming loose when the unit is moved. All doors and drawers must be equipped with locks.

Portable items such as stools, vacuum cleaner, and mobile projection stand must be equipped with some type of holding device for securing during transit. All machines must be fastened to bench tops or to the floor. The bench drill press, grinder or scroll saw must be bolted securely to the bench top.

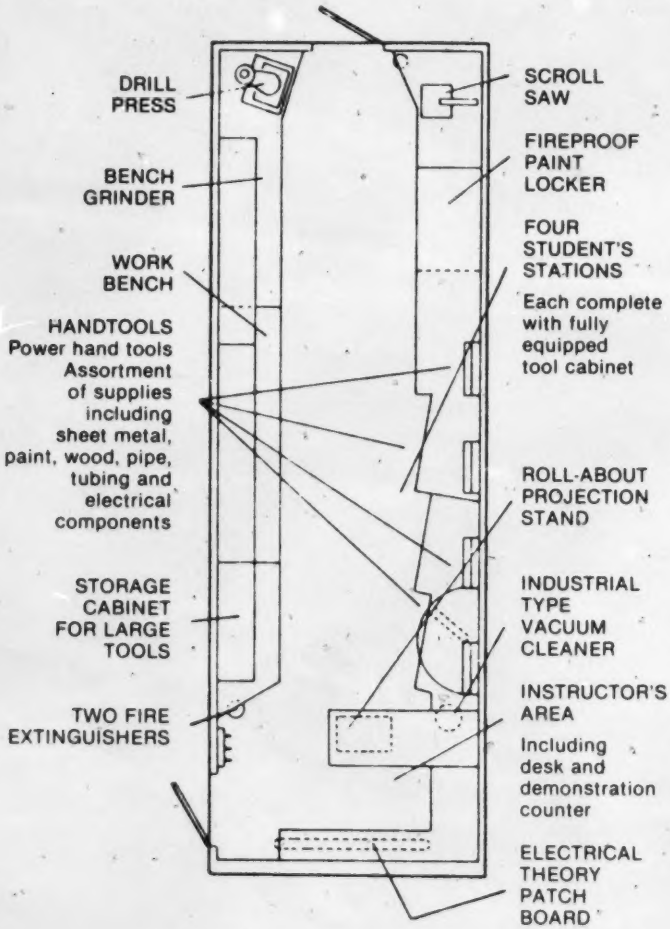
Storage cabinets must also be equipped for transit. Doors must have locks. Shelves should have a raised panel on the front edge to help secure the materials stored on them. Small bins or the use of tote trays in cabinets would help prevent materials from moving.

If open shelves are used for storage of materials such as lumber, metal or other large materials, the shelves can be made so they have raised fronts. Sloping shelves and removable panel covers also provide the needed security.

The mobile lab should be equipped with adequate utilities. Electrical service, provided through a permanent heavy duty flexible cable, should be a minimum of 3-wire 110/120 volt, 1 phase, 100 ampere service. Water connections to a sink must be provided with drains so water can be drained during cold weather. Waste drains should likewise be provided with some means of draining during freezing weather.

Ventilation is needed, especially when activities which produce fumes or dust are undertaken. If screen printing is done, for example, the fumes from the inks and solvents must be removed while provision is made for providing fresh air replacement. A darkroom must be equippped with a light-tight ventilation system.

A heat pump system seems to offer a good solution to the problems of



heating in winter and cooling in summer. In the typical mobile unit, which is rather small for the number of people using it, air conditioning is a necessity.

The floor plan for a mobile lab schown below is presented as a starting point from which a lab can be designed to meet specific local needs. The tools and equipment provide for the use of a variety of materials and processes. The industrial arts teacher using this lab would have the capability to work with teachers in the school and provide a variety of hands-on experiences to supplement any of the elementary curricula.

Portable Equipment

In many elementary schools, portable equipment is provided which can be moved among the various classroooms as needed by the teachers.

The requirement for the designing of such equipment is not unlike the mobile classrooms discussed in the previous section. Provision must be made to secure the tools and materials during transit. The portable equipment can be classified into three categories discussed here: work surfaces, materials storage, and tool storage.

Work Surfaces

There are several different ways of providing a working surface for elementary industrial arts activities. The table s in the classroom can be used quite adequately. The major shortcoming of these is the lack of vises or other ways of holding work. This can be solved by using "C" clamps or wood handscrews to clamp the work to the table. If the classroom is fur-

nished with individual student desks, some other provision must be made for a working surface.

In several commercially made units such as shown below, the panels from the front of the tool storage cabinets are used for the work surface.

As several writer have noted, the floor is an excellent work surface for many activities. It is flat; if tiled, it is smooth; and elementary aged students seem to set and work on the floor naturally.

Materials Storage

Normally, in an elementary industrial arts program, a large variety of materials must be stored. At the same time these materials must be readily avilable to the students.

When implementing a program of industrial arts activities in the elementary school, it is often best to make a modest beginning and let the equipment and supplies accumulate as needed in the program. Quite often this is done by adding tools, funiture, and supplies in a classroom or establishing an inventory for the school that can be moved among rooms as needed. Material's carts can be used to store and transport materials.

Tool Panels

Tool panels and carts must be designed so that the tools are clearly displayed, but at the same time can be moved when necessary. Tool holders should be designed so that the tools will not fall off when the panel is moved.

General commercial units are available. Others can be constructed by a competent woodworker. When the tool panels are purchased or built, they should be designed to hold the variety of tools used in the program. When only woodworking tools are provided, only woodworking activities tend to be done. These tool panels and carts can also be outfitted with tools for metal working, plastics, ceramics, and a variety of other activities.

Technology Activity Centers in Regular Classrooms

The technology activity center consists of any one area withing the classroom which has been established temporarily or permanently for the purpose of providing students differentiated learning activities and experiences. This type of environment exists in self-contained classrooms as well as open-space schools, when workspace, tools, and materials are provided for industrial arts activities. It is sometimes referred to as the technology corner, invention center, or the construction center.

The extent to which the center is organized is important not only for purposes of instruction but also for effective classroom management. There are no "packaged" systems to purchase. Therefore, space must be carefully defined and designated by the teacher. Considerable thought and planning should go into the development and physical arrangement of the center so that the activities appeal to students and so that its scope and sequence are sufficiently understood to minimize disruption.

A section of the classroom may be inexpensively established as an activity center by using tables, bookshelves, and storage cabinets along with movable screens and chalkboards. Demountable partitions or operable walls may also be used. A demountable partition can be assembled, disassembled, and re-erected to accommodate shifts in the activities.

Operable walls are flexible partitions which can be used to divide a space at a moment's notice by folding or sliding. All of these items are useful as dividers in separating the activity center from the rest of the classroom.

The use of furniture and/or partitions also provides insulation from unwanted sound and interference. The treatments for unwanted sound is very crucial for the success of any technology activity center. The degree of sound interception required in a techology activity center depends upon adjacent activities and other classroom arrangements. Where a quiet activity is next to an activity center, the boundaries surrounding the center must be high enough to intercept and reduce noise levels.

The technology center, which often requires the use of water for various constructional activities, may be appropriately located at the site of the classroom sink and its adjacent counter tops. This would also minimize the problem of cleaning up after each session.

Sufficient space for ease of movement within the center is mandatory. Chairs may not be needed within the center. Standing or sitting on the floor is appropriate. The flexibility of the environment imparts the feeling of freedom necessary for creative expression and the prusuit of knowledge. The use of wall space for pegboards on which to hang tools and other devices is an efficient way to overcome the problem of limited storage space.

The accessibility of diverse tools and materials in an activity center for constructional activities should help to encourage students to experiment with many different types of systems thus capitalizing on variances in learning styles. A wide variety of technological concepts can be learned by utilizing simple hand tools to "build things" from wood blocks, elastic bands, coffee cans, wire, string, sticks, empty bottles, shoe boxes, as well as from more conventional types of materials. These materials should be stored in clearly designated places in the center.

The technology activity center may constitute a corner of the room with a desk or an area enclosed by expensive partitions. Nevertheless, it should provide an atmosphere conducive for experiencing technology as an essential part of the elementary school program.

Conclusion

The mobile classroom, mobile carts, and activity center can provide excellent instructional environments for organizing students, teachers, and learning materials for the elementary industrial arts program. Each of these facilities is sufficiently flexible to meet the diverse needs of the learners and future curricular changes. The choice of facility or specifications of activity space will depend on long range program goals, school size, population served, financial resources available, activities and tools to be used.

Diagnosing Children's Needs to Prescribe Instructional Activities

by

George Baker

The need for activities in the elementary school is quite real and quite obvious. However, in many schools the resources, both financial and human, are stretched extremely thin because of the limited scope and scale of the educational institutions. In many elementary schools special teachers or resource teachers such as the industrial arts specialist are not available. Sharing and making do is a way of life for man elementary classroom teachers.

Elementary industrial arts has proven itself to be a rich and valuable component of the elementary school curriculum, yet for all the potential it has displayed it has been very difficult to make a significant impact in the schools of America. As a teacher educator faced with the responsibility of developing this rich potential as a part of the pre-service and in-service teacher education program for elementary and special education teachers, it became obvious that a delivery plan needed to be developed which was tailored to the needs of the teacher and was capable of being integrated into the regular classroom.

The Plan

As assessment was made of the elementary and special education teachers, to determine their perceived outcomes of offerings in existing industrial arts activities. This early interaction confirmed the suspicion that there was a need to refocus or at least reinforce the child-centered teaching process. Teachers tended to internalize the content areas and the vehicles of instruction as the end in themselves. Projects, processes, and units of instruction became the end products rather than the student growth and achievement along predetermined lines.

How could the emphasis be redirected by the educational process within the bounds of the teaching environment resource parameters? The approach chosen was prompted by the methodology used by current special education programming. Because of the multiple and interrelated nature of many of the handicapping conditions of special education students, one of the more effective methodologies has proven to be the diagnostic/prescriptive process. Essentially, the process required that the teacher use diagnostic measures, either personally or through diagnostic services, to assess the nature and extent of the person's handicapping condition. After diagnosis, it was possible to develop a profile of the individual's strengths as well as developmental or corrective needs. With this achieved, it was possible to assemble and prescribe learning activities which responded to the student needs and promoted the greatest degree of **appropriate** growth and achievement.

Using the diagnostic/prescriptive concept as a point of departure, a plan was developed which would provide teachers with ways of using exposure in industrial arts and similar experiences to meet the needs of children. For the purpose of the delivery plan, these discipline or content areas were given secondary priority to their use as a vehicle to meet the comprehensive student needs. Emphasis was placed on the diagnosis of need and the development of short-range and long-range goals and objectives. This should not imply that these discipline areas were eliminated from programming, but rather their use was encouraged as a vehicle to aid in achieving the identified goals and objectives of individuals or groups of students.

The initial step in the plan was to develop a diagnosis of the children's needs. When this diagnosis or needs assessment was completed, it was possible to look at the established goals and objecives of the curriculum and compare the needs of the students, either by groups or individually, against the established goals and objectives and develop some instructional priorities. It was here that the greatest professional judgment was required. The teacher must exercise the greatest discretion in the selection of the most appropriate objectives for the students. The teacher will soon learn that there is no easy formula or magic equation to follow. It becomes impossible to follow an annual plan with well established and routine yearly activities. Each year, each class, each student, is different and unique. Each deserves to be treated as individually as possible, and the needs must be reevaluated as often as possible within the realm of reason and resources.

To insure the relevancy of educational activities and to eliminate indiscriminate teaching, the use of written objectives, preferbly performance objectives, was recommended. The teachers were encouraged to write the types of outcomes to be expected, expressed in student performance, for each of the students at the completion of the learning activities. These objectives were to provide direction in the selection of learning experiences and to provide criteria against which to evaluate the effectiveness of selected learning experiences. The objectives and the learning activities represented the prescription. As with a medication prescribed by a physician, if the learning activities and the objectives were timely and appropriate, the learning defficiency of the student was cured.

Problems and Benefits of Diagnosing Children's Needs

The diagnosis of children's needs at first generates visions of illness and disease and can be a somewhat forbidding concept. After consulting a dictionary, it was learned that one definition of diagnosis was "a scientific discrimination or critical scrutiny resulting in a judgment." Diagnosis is well-known to the classroom teacher because each day of a teacher's life it is necessary to make judgments based on observations. One of the goals of this chapter is to encourage and emphasize the scientific, discriminative, orderly process associated with diagnosis.

Unfortunately, when initiating a diagnosis process in an educational

environment, the teacher is faced with a number of problems. First, the teacher is likely to approach the concept of diagnostic education with a degree of apprenhension and anxiety. Concern over the amount of time involved with diagnostic processes and the feeling of a lack of expertise in the diagnostic processes tends to deter teachers from attempting the process. In addition, some teachers feel concerned because of the legal implications and the general hassle that is perceived as a possible outcome of utilizing a diagnostic process. An additional deterrent is a lack of diagnostic resources and support personnel to aid the teacher.

On the positive side, diagnosis of need can make a real difference to student achievement. It provides a mechanism to identify and prioritize needs and provides hard data to use in establishing teaching goals and objectives, as well as aids in selection of learning activities. While the teacher may have apprehensions and feel inadequate with first experiences with diagnosis, it must be kept in mind that the teacher has training and experiences which lend themselves to the utilization of this process. In addition, the classroom teacher has the greatest opportunity to ineract with the students of the class and the opportunity to develop the greatest degree of insight into the needs and problems of the class and individual members of the class.

What May Be Diagnosed?

The diagnostic process will be determined by a number of variables. The resources of the school, both financial and personnel, the makeup and size of the class, teaching load, and similar variables will dictate the extent of teacher involvement. It is the responsibility of the teacher to select from a wide array of diagnostic possiblities and to identify and prioritize the areas which the teacher feels are most appropriate to expend energy and teaching resources. The following list is offered as an example of the developmental areas which may be of concern to the teacher. It is by no means all inclusive nor is it keyed to specific grade levels or the needs of a specific grouping of children. It is offered as a point from which a teacher might begin developing objectives and teaching experiences specific to the needs of students.

Knowledge: "Traditional Curriculum Areas"

- Health/Safety
- Math
- Science
- Social Science
- Language

Physical/Sensory Development

- Gross Motor-Fine Motor
- Perceptual Motor Match "Kinesthetic, Tactile, Balance, Coordination"

Emotional Development

- Achievement
- Socialization
- Compromise
- Motivation
- Personality
- Affiliation/Acceptance
- Freedom/Conformity
- Attitude
- Self-Image/Self-Concept

Reasoning, Problem Solving, Creativity
Basic Skills
- Expressive Language
- Language Reception and Perception
- Number Facility

Perception of Form, Space, Time, and Direction
Vocational and Career Development
Avocational Development

This listing provides the basis for scientific discrimination or critical scrutiny as outlined in the previous definition. It can provide the first step in the development of a diagnostic profile for the student (Kost, 1972, & Lillie, 1975).

Developing The Diagnostic Profile

To develop a diagnostic profile, it is necessary to identify what the student should be able to do or the levels to which a student should have matured at the completion of the period for which the teacher is professionally responsible. Next, it is advisable to identify prerequisites or those things which the teacher feels a student needs when they enter a class, if they are to achieve the stated goals and objecives. These need not be precise but should represent a strating point from which to derive and define goals and objectives for each individual.

In the process the teacher will find it is a good idea to begin developing a profile of the student early in the year. One way to begin is to check the students against prerequisites as they enter the class to determine if remediation is needed from the beginning. The teacher should develop a file folder on each student. This, by necessity, will be a hodgepodge of bits and pieces of information from a wide variety of sources. In any event, the teacher should not rely on memory. Materials gathered from standardized tests and information from the student's school file may be compiled. Develop anecdotal records of student behavior as it occurs and drop these records into a student's file folder at a later time. This is much easier than attempting to later recall the actions or significance of a student's behavior. Also helpful is the maintenance of class achievement charts and records of parent conferences. Attempt to sample the child's behavior at different times of the day, noting any deviation from what is considered normal behavior. Children who lack energy, who are listless and lethargic, who become tense and irritable toward the end of the day, who are tired early in the morning, who lack emotional control, who perform at lower levels than their peers, and other deviations from the norm should be noted. As the file on the student begins to develop, the teacher will note that patterns may be observed for certain students and clues may be developed as to deficiencies or needs within students (Margolin, 1976, pp. 327-28).

On a systematic basis, the teacher should include such samples of the student's work as drawings, homework assignments, and any other physical evidence which might provide a longitudinal record of the student's

response, growth, and achievement. This physical evidence provides an excellent way of assessing the student's progress at regular intervals because it is very difficult to remember the subtleties of student performance over a period of months.

As the store of information and the folder of materials relating to the student grows, it will be the teacher's responsibility to provide security for this somewhat sensitive information. These materials are not for view by the public and should be shared only with individuals such as school administrative personnel, counselor psychologists, or parents with whom the teacher needs to communicate. These records are not public domain and the information enclosed in the file should be treated with the same degree of confidentiality that a doctor or lawyer would exercise with the information possessed about clients and patients (Margolin, 1976, p. 330).

The Prescription

As the information is accumulated to diagnose student needs, the ongoing process of prescription must be undertaken by the teacher. Throughout the year, the teacher is required to revise, modify, and reprioritize the objectives of groups or individual students as information gathered in the diagnostic process points to new needs and problems which must be addressed in the educational process. This is the most trying portion of the process because the teacher is required to **prioritize** the many needs so as to select those which have the greatest amount of impact upon the intellectual and physical growth, maturation, and development of the students. The teacher must also consider the needs that can be addressed within the school environment and in the partiuclar classroom. One of the most frustrating aspects of teaching is that almost inevitably, more needs are discovered than the teacher will have time and resources with which to deal. The prescription will be concerned with two things. First, objectives must be identified or modified to be responsive to or appropriate in terms of needs identified through the diagnostic process. Second, the learner appropriate objectives must be reflected in the structure of the learning environment and the selection of learning activities.

The Contribution of Industrial Arts Activities

It is only after **learner appropriate** objectives have been identified that learning activities should be planned. It is at this point that the contributions of industrial arts, and other activity areas should be considered for the possible contribution to the overall growth and development of the students. For instance, if the teacher looks at the list of things which might be diagnosed and discovers that a student has problems with socialization and has difficulty affiliating with other students, one option which could be considered is the development of a small group activity or project through which each student would be given the opportunity to work with other individuals toward a common goal. This sort of activity might have multiple objecives. For one student, the primary objective may be socialization, but it may provide the opportunity for problem solving and creativity to

another student, and at the same time it might be used to develop basic number facility of arithmetic skills for yet another student. Another example may be when the teacher wishes to develop knowledge or skill in a traditional curriculum component, such as math or science, the teacher might choose a project in which the entire class would participate and contribute. In this instance, the class would work on a single project but individual members would be assigned to work on units of the class project which would contribute to their individual needs. While some individuals would be working on deficiencies, other might be building upon strengths or skill. Each of the students would be learning a basic knowledge or skill which is central to the class needs.

One of the outstanding features of industrial arts and other activity oriented processes of instruction is that it works so well in so many ways. It can be used with a total class project, with small groups, and with individuals. It can be integrated with community based activities or with volunteers and resource people to expand the horizons of the stduents and enrich the educational experiences. These experiences might be used as homework assignments which involve the family, clubs, church activities, or any number of home and community based associations. It can be equally effective in enabling the individual to develop at markedly different rates toward rather unique goals and objectives and in accommodating personal interests. Industrial arts allows for individual motivation and reward and enables an individual or a few students to work independent of the rest of the class. This might take the form of a quiet area for those individuals who have completed their assigned tasks on group projects and wish to retire to work on projects of personal interest and explore and develop personal goals.

An Example

To better understand how this process might be integrated into the classroom, consider the example of the student who has difficulty affiliating with other students. Because of the difficulty in affiliation, peer acceptance and self-image suffer. The objective of the teacher is to improve the affiliation skills and improve their acceptance, thus contributing to a more positive self-image.

The teacher is fully aware that changes of this type normally take a great deal of time (it took quite a while to develop existing attitudes and responses). The teacher decides to integrate the learning experience for this student with a series of objectives in the ongoing math curriculum. The prescription is to integrate the math unit, which seeks to reinforce recognition of geometric shapes, and to develop skills in the addition and subtraction of mesurements. This will be done by building and later using a simple geometry board using wood and nails. Measurement and the addition and substraction of measurements will be used in the specification and distribution of materials, laying out, cutting, and finishing of the board, laying out nail patterns, and driving the nails.

Improved affiliation skills will be achieved by use of small group organizations and the use of student group leaders. The method of achieving this objective will rely heavily on role modeling. The application of the prescription will be as follows:

1. After the project has been selected and materials secured, introduce the project to the class.
2. Organize students into small groups and choose initial group leaders who will provide desirable role models.
3. Outline the role of the group leaders and each member of the group.
4. Allow students to work in groups under the direction of the group leader.
5. After students who need to develop affiliation skills have had an opportunity to work with the witness appropriate group dynamics and affiliation skills with the group leader, the leadership of the small group may be rotated so that the individual with affiliation needs may assume a new responsibility, develop and test the needed skills.
6. Evaluate the progress of the student and update prescription according to the needs of the student.

Conclusion

The concept of using the diagnostic/prescriptive process with elementary industrial arts has been proposed as a method of meeting the needs of youth. In order to achieve the **greatest benefit** from the limited resources of any school environment, the use of a diagnostic process is recommended to aid in the identification and development of educational objectives and **prioritization of these objectives**. Industrial arts and other activity-oriented vehicles of instruction are recommended to be included as part of the instructional activities because of the ability to enrich the curriculum, to motivate students, to provide flexibility, and to respond to a wide array of student educational and developmental needs.

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